Electrical World and Engineer

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "ELECTRICAL ENGINEER."

VOL. XXXIX. NEW YORK, SATURDAY, APRIL 12, 1902. No. 15.

ELECTRICAL WORLD AND ENGINEER
(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

PUBLISHED WEEKLY.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

J. M. WAKEMAN, - - - - - - - President and General Manager.

CHICAGO OFFICE, - - - - - - - - - - - 1139 Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - - - - 929 Chestnut Street.

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ELECTRICAL WORLD AND ENGINEER.

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Entered as second-class mail matter at the New York Post Office.

NEW YORK, SATURDAY, APRIL 12, 1902.

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MUNICIPAL OWNERSHIP.

The citizens of Chicago have just relieved their minds on the subject of public or municipal ownership. Lured and deluded by all kinds of wild promises and absurd statements as to what can be done and saved by means of municipal plants, they have voted overwhelmingly in favor of two proposals. One is that the city shall own and operate all the gas and electric lighting plants. The other is that the city shall own and operate all the street railways. Either scheme would be ambitious enough for a community which even now is in bad financial shape, but taken together they represent the extreme of civic unwisdom. Fortunately, the vote is merely a "referendum," an expression of opinion, not a mandate or a contract. There are many things that most of us would vote in favor of, but not if it involves serious financial issues. The *New York Sun*, in commenting on the situation presented, remarks very shrewdly:

"The magnificence of the majority may be due in part to the fact that municipal ownership is and long or ever must be a speculation and a dream so far as Chicago is concerned. The city is so far from having money to burn that the municipal 'ghost' is very tottering and uncertain in its walk. The stupendous debt that would have to be incurred were the city to go into the railroad, gas and electric lighting business was not before the voters as an actuality or immediate probability. But the decided expression of their opinion will encourage the numerous Democratic statesmen who believe that the municipal ownership of public utilities is a promising issue to coddle. Their troubles will begin when the scheme advances from its present gaseous state into a condition of concrete and figure-laden reality."

AMERICAN ELECTROCHEMICAL SOCIETY.

The formal organization last week at Philadelphia of the American Electrochemical Society added another to the technical bodies which nowadays are such potent factors in industrial progress and professional advancement. Few, if any, of the older professional bodies were inaugurated under auspices as favorable as this latest comer. Though the first steps toward its organization was taken but a few months ago, the Society enters upon its career with little short of 400 members, and with a record made at its first meeting which places it at once in the front rank of professional bodies, not only of this country, but of the world. Indeed, the Philadelphia meeting was of such a high order of merit that to keep future meetings up to the standard there set may become a difficult task. On the other hand, the fact that the twenty papers read at Philadelphia were, with but a few exceptions, contributed without solicitation, and in view of the gigantic strides with which the electrochemical industry is progressing, there is every prospect that the *Proceedings* of the Society will continue to present contributions of high value to the science and the industry.

Aside from the functions of the Society relating to the reading and discussion of papers, it will undoubtedly exercise an extremely beneficial influence in bringing about a much-needed professional community of ideas, and in aiding the development along proper lines of the teaching of electrochemistry. Heretofore there has been in this country no solidarity in this newest branch of electrical development, doubtless because of its sudden rise to importance, and also because of the personnel having been recruited from many diverse sources. The chemists, metallurgists, electrical engineers and others who have cast their lot with the new branch had in their earlier career little in common professionally, and these the Society will now bind together and inspire with a true *esprit de corps*. At the Philadelphia meeting it was suggested that the annual general meeting of the Society be held in connection with the annual convention of the

American Institute of Electrical Engineers. We sincerely hope that this suggestion will be given practical effect. Those who design, construct and erect the machinery for electrochemical operations will be interested in the papers read dealing with the processes, which, moreover, they can intelligently follow from their general knowledge on the subject derived when they were electrical engineering students; and electrochemists will be similarly benefited through maintaining touch with the dynamical branch of electricity and its personnel.

The twenty papers read may be classed under the head of educational, controversial, descriptions of new processes and contributions to electrochemical science. The discussion which followed the reading of Prof. Richards' paper on "A University Course in Electrochemistry" very clearly showed that this subject is in a vague condition. It was inevitable that differences of opinion should arise as to what branches the student should be proficient in previous to taking up the study of electrochemistry, for this is a problem encountered in connection with every professional course. At the present time a considerable portion of a technical course must be devoted to preparatory studies in branches which, though essential, should logically be pursued beforehand in order that the entire time of the student may be given to the science and technics of the profession which he proposes to enter. Another point brought up was a distinction between a course for an electrochemist and one for an electrochemical engineer—a distinction corresponding to that existing in electrical engineering between the designing engineer and the constructing and operating engineer. We are inclined to believe that the time is coming when no attempt will be made, as in the past, to graduate full-fledged professional men; and that the teaching in schools will be confined to the inculcation of scientific principles which will enable the graduate to enter into a professional apprenticeship in any particular branch for which he feels best adapted, or which appears to offer at the time the best opportunity. In electrical engineering proper, the situation is now ripe for such a course of education; for at present, instead of an electrical engineering graduate being considered a professional man, he is becoming more and more to be regarded merely as raw material, and there is little prospect of his advancement until after a professional apprenticeship of several years.

The papers on new processes and cognate subjects numbered seven, of which at least five dealt with processes, holding forth great possibilities, namely, the electrolytic production of caustic alkalies and chlorine, of bisulphide of carbon, of lead, of zinc, and the electrolytic refining of composite metals. Details relating to these processes will be found in our report of the meeting of the Society. Papers on what may be considered the theoretical branch of electrochemistry were eight in number. Those of most importance were one by Prof. Carhart, on a new type of concentration cell, and another by Prof. Bancroft on a promising application of the Gladstone-Tribe couple. A new type of storage cell described by Mr. Dow is interesting from the fact that it may serve as a standard of e. m. f., since it has a very definite voltage, and after current has been drawn from it the voltage immediately regains its normal value. A paper by Prof. Richards considered electrolysis by alternating current, and set forth an electrochemical explanation to account for what, when the phenomenon was first noted, appeared to be an anomaly. A study by Prof. Burgess of the electrolytic rectifier adds considerable to our knowledge of this subject and is particularly instructive from the fact that it shows that much better results may be obtained from the use of fused than from aqueous electrolytes. The youth of the new Society may be said to have been well exemplified by the polemical nature of several of the papers presented and of parts of the discussion. One paper attacked the nascent state theory, and offered both argument and data from experiments to show that it is entirely unjustified. Another made an onslaught on the "atom of electrochemistry," and a third assaulted the Nernst theory of electrolytic dissociation. In addition, an experiment was described which apparently invalidated the osmotic pressure hypothesis, and several times during the discussions the ionic theory received some sharp raps. Without entering into the merits of the several controversies we would suggest that an excellent purpose might be served by taking up in turn as subjects for discussion by the Society, the various controverted points in electrochemical theory. By distributing papers in advance presenting the opposing views, their discussion would do much toward clarifying the atmosphere, even should it not definitely decide the issues. In view of the eminent names connected with the modern theories, and the undoubted impetus they have given to investigation, with often results of extreme value regardless of the validity of the source of inspiration, they deserve the most studious consideration and courteous treatment.

Electric Resistivity of Iron.

Following closely upon a paper recently read by Professor Barrett and a collaborator, on the magnetic properties of iron alloys, before the British Institution of Electrical Engineers, comes a very interesting and important paper by Professor Barrett "On the Increase of Electric Resistivity Caused by Alloying Iron with Various Elements," read before the Royal Society, Feb. 6, 1902. The paper describes the effect of alloys of a single element with iron, as determined from 68 specimens. These specimens contained varying small quantities of carbon, aluminum, silicon, chromium, manganese, nickel, cobalt and tungsten, one metal at a time alloyed with iron. The specimens were drawn into rods about 5 mm in diameter, and their resistivities determined at about 18° C., or at ordinary temperatures. Curves are plotted in the paper, showing that in all cases, with a questionable exception as to copper, the resistivity increases with an impurity of these seven metals; and, moreover, the greater the amount of impurity, the greater the resistivity. In fact, with the exception of nickel, the graphic relation between percentage impurity and resistivity is practically a straight line from 0.25 per cent up to 15 per cent of impurity. The straight line has a very different slope, however, with different metals. Thus, with tungsten the inclination is quite gentle, representing only 2 per cent increase in resistivity for 1 per cent of impurity; whereas, with aluminum, the line is steep, representing 14 per cent increase in resistivity for 1 per cent of impurity. The steepnesses of these lines—that is, the tangents of their angles of slope, or, the increase in resistivity for 1 per cent of impurity—would seem to be roughly in proportion to the specific heat of the metal. Thus tungsten has a relatively low specific heat, and a low slope of resistivity in terms of percentage impurity; while aluminum has a relatively high specific heat, and large slope. The agreement is not very good for cobalt, nickel, and chromium, but this is possibly accounted for by the fact that the atomic weight of these metals is near to that of iron itself, and the proximity may entail some secondary interference. For carbon the rule is entirely incorrect; but, for that matter, the specific heat of carbon is also erratic, so that this substance does not fairly count. The rule is moderately well observed for tungsten, manganese, silicon and aluminum.

Since the specific heat of any of these substances is known to be approximately proportional to the atomic volume, the rule means that the rate of increase of resistivity with impurity is roughly proportional to the atomic volume of the impurity or the volume occupied by an atom of the impurity. The rule is only tentative at present, and Professor Barrett merely indicates that the proportional agreement between these two quantities appears to be more than a pure coincidence. It will be necessary to accumulate more materials, more alloys, and more observations, before any definite conclusions can be relied upon; but this is the first ray of hope that has yet shone upon the perplexed subject of alloy-resistivities, which hitherto has been murky and chaotic. The rule, moreover, implies something more, if it is correct. It also means that since the atomic volumes and specific heats are inversely as the atomic weights of elementary substances, the rate of increase of resistivity with single-metal impurity must be inversely proportional to the atomic weight of the impurity. In fact, if the reciprocals of the atomic weights of the

metals here considered be plotted as ordinates, to percentage of increase of resistivity for 1 per cent of impurity as abscissas, the points fall more nearly on a straight line through the origin than do the specific heats taken by Professor Barrett. Consequently, the rule would make increase of resistivity with impurity depend either on the atomic volume directly, or on the atomic weight inversely; which ever conception lends brighter color to the view.

It is to be hoped that the rule can be definitely proved, for it cannot fail to assist the development of any theory seeking to explain the nature of metallic conduction. From the standpoint of the dynamo and transformer designer, aluminum and silicon are the right substances to alloy in minute degree with iron; because 2 per cent of either quadruples the resistivity, and therefore quarters the eddy current loss at constant temperature; while at the same time, according to Professor Barrett's results, the permeability of aluminum-iron is notably increased. If the 2½ per cent of silicon or aluminum present in the alloy is actually useful in extracting and holding oxygen that would otherwise combine with the iron, it is only reasonable to suppose that the presence of alumina, or silica, also prejudicially affects the iron, although not to the same extent as the oxygen which these metals unite with. Consequently, if the oxygen could be entirely removed in the preparation of iron, without leaving any substance in its mass, the iron should be still softer and more permeable magnetically. It is just possible, therefore, that no really pure specimen of iron has ever yet been produced, or tested, and that such pure iron, if obtainable, might be notably superior to existing brands in freedom from hysteresis and coercive force.

The Principles of Grounding.

In another column will be found an interesting contribution to the theory of grounded circuits. The subject is one which has gradually been assuming considerable importance as high voltage systems have become more and more common, and current practice has not settled into any well-defined lines regarding it. The traditions of the past unite in abhorrence of grounding on general principles, and there has been a strong tendency to look upon the suggestion of deliberate grounding as a manifestation of acute alternating current mania, quite unworthy the attention of any sane and conservative man. Now we agree that twenty years ago when circuit meant arc light circuit an accidental ground was most unwelcome and a deliberate ground quite unthinkable. But the world moves and new ideas have to come. As high voltage lines, especially polyphase lines, have become common the question of safety precautions has grown in importance. It is now well established that grounded secondary circuits are not only advisable but well-nigh necessary to ensure safety on high-pressure alternating circuits, but even now the idea of deliberately grounding the neutral point of the main transmission system is not always well received. Yet, as Mr. Nies very clearly shows, such a procedure is advisable from almost every point of view. Even assuming the circuit to be insulated from earth, he shows that the existence of capacity as between the wires and ground renders quite illusory any hope of safety based upon perfection of line insulation. It is this feature of the matter that gives Mr. Nies' paper a special claim to consideration.

Modern high voltages, and indeed all voltages above the modest requirements of a local distribution system, involve an element of danger that should properly be conceded without argument. So do railway trains, steamships, and elevators, and the practical problem with which humanity has to deal is not how to provide means of horizontal and vertical progression which shall be as safe as staying at home, but how to guard the most useful apparatus at hand so as to avert all unnecessary risks. So it is with electric circuits. Granted the importance of high voltage, we should set to work to utilize it as safely and effectively as possible. Now suppose one is dealing with a star three-phase system worked at 10,000 volts between the phase wires and the neutral point. Is it safer to ground the neutral point or not? Grounding it makes one sure of approximately 10,000 volts between wires and ground all the time. If it remains insulated, one may get considerably less than this voltage to earth from a single contact or is reasonably sure of catching about 17,000 volts if the circuit is otherwise grounded. So far as earth contacts are concerned, grounding effectively limits the active voltage to 10,000, but that pressure has to be dealt with all the time. In the other case an earth contact may give anything from zero to the full delta voltage. The relative safety of the two cases hinges upon the probability of maintaining the line insulation. Now the merest tyro in high voltage work knows that it is well-nigh impossible to keep a long line insulated from the electrostatic standpoint. It may be excellently insulated so far as material leaks are concerned, but it should always be looked upon as grounded with respect to earth contacts. Hence, as a purely practical matter, grounding the neutral point tends upon the whole to lessen the voltage available for accidental contacts. When, however, all the voltages likely to be involved are far above those that can be safely handled, the actual danger is not greatly modified. We are strongly of the opinion that for all practical purposes all the line voltages in common use for alternating current working are substantially alike in the matter of general safety. The very high voltages require, and receive, more careful insulation to secure a steadily operative line, and in point of fact most of the troubles on transmission systems are on the secondary rather than the primary voltage.

The particular feature of high voltage systems to which Mr. Nies has drawn attention is the effect of capacity in the line upon the contact voltage between line and ground. He shows very neatly that with the line constants and voltages in common use, insulating the line as a whole from earth does not materially decrease the probable danger of a contact. To put the matter roughly, the condenser effect ensures a dangerous voltages between line and earth except in the presence of heavy grounds. This being so, one cannot avert danger by complete insulation, so that, on the whole, the probable voltage of an accidental contact is less with a grounded system than with an insulated one, even supposing complete insulation to be feasible. In this state of affairs it would seem the part of wisdom to ground freely. The practical objections to grounding arise from a somewhat increased chance of getting severe grounds from single contacts in trees and such like places which might not produce operative difficulties if the lines were approximately insulated. On the whole, however, we are inclined to the opinion that a good savage ground that is at once evident and requires attention is preferable to one that goes to work in a half-hearted sort of a way and encourages temporary neglect. Lines should be kept clear and no system gets into comfortable operative condition until they are substantially clear. Grounding the neutral point gives the advantage of a definite working condition and a known element of danger—always an advantage over uncertainty. As to grounding secondaries, there seems to be no difference of opinion, and in fact we believe that failure so to ground has been held to be negligent in case of an accident arising from contact between primary and secondary. As the general art of insulation has improved the early objections to grounding have in large measure disappeared, so that at the present time the advantages of grounding can be gained without incurring material disadvantages. It is always an advantage to deal with known and determinate conditions, and when, as Mr. Nies has shown, safety does not lie on the side of attempting perfect general insulation, grounding the neutral would seem a procedure usually desirable. Lines must be well insulated for operative reasons, but this is quite a different matter. As to personal safety, the most effective insulation is a wide gap between the person and the line.

New Lights and the New York Electrical Society.

The auditorium of the new Lucas A. Steinam annex, Hebrew Technical Institute, was barely large enough to hold the audience which listened to Dr. Max von Recklinghausen's lecture on "Recent Developments in Electric Lighting, particularly in reference to the Nernst and Cooper-Hewitt Vapor Lamps," before the New York Electrical Society, on the evening of Thursday, April 3. Dr. Recklinghausen led his audience by easy and interesting stages from some of the more rudimentary phenomena of artificial lighting to its latest and in many respects most wonderful developments.

After describing and showing the Nernst lamp in all its details, the lecturer noted that in the arc lamp field we have as a newcomer the Bremer arc lamp, using composition carbons and giving an extremely efficient light of a color that has nothing of the strange blue of the arc lamp.

The latest development in electric lighting, he said, is the Cooper-Hewitt lamp, the first high candle-power illuminant based on the incandescence of a vapor or gas. The Hewitt mercury vapor lamp has a negative electrode made of mercury and a positive electrode made of iron or of mercury. The lamps used by Dr. Recklinghausen in illustration ran on direct current of 115 volts, consuming 2.8 amperes; they gave about 700 candle-power each, that is, about nine times the efficiency of the incandescent lamp. They showed little or no deterioration after being used over 800 hours. The Hewitt lamps are extremely actinic and are therefore already very valuable for all photographic processes. The Hewitt light is—strange as it looks for the first time—more agreeable to the eye than any other illuminant. This is confirmed by many people who have been using it for reading, draughting and fine mechanical work.

After mentioning some important points to be considered when comparing illuminants, such as their diffusion, hygienic properties, etc., the speaker concluded by saying that the keen competition in the field of lighting has worked to a very great extent to the benefit of the general public.

Before the lecture the laboratories and other departments of the Institute were thrown open to the inspection of members and the admirable equipment of this most progressive and efficient technical school was examined with the closest interest. After the lecture a collation was given, a warm welcome being extended to the Society by Mr. Joseph Wetzler, a past president of the Society, who has been for many years secretary of the Institute and one of its hardest working supporters.

The new badge of the Society was on exhibition, and many orders for it were received by the secretary.

Electrical Engineers of the Day—XLI.

ORVILLE H. ENSIGN.

Orville H. Ensign was born in Ithaca, N. Y., on July 8, 1863. At the time of his birth his father, H. W. Ensign, was a captain of a company of United States volunteers at the front. After passing through the common schools he prepared for college at a high school and entered Cornell University with the class of '84, taking the course in mechanical engineering. Viewed from the average college standpoint, the path of young Ensign was not an easy one, for he was compelled to earn a material part of his expenses through college and at last, after two years, he gave up his university work and became entirely responsible for his own career.

Soon after leaving Cornell, Mr. Ensign become connected with the Schenectady Locomotive Works, but then had the good judgment and courage to enter a new field by accepting a position offered by the United Edison Company, of New York. Mr. Ensign elected to leave Schenectady for New York City in the belief that the electrical career was the one of the future. His first electrical work was in the installation of isolated plants, and for a while he had charge of the trouble work in isolated plants for what is now Greater New York. In the fall of 1887 he was promoted in charge of isolated plant work for the State of New York under the State agents of the United Edison Company. This position was held until the Edison General Electric Company was formed in the winter of the succeeding year, when Mr. Ensign, then a young man of 25, entered the Edison General factory at Schenectady in order to make his knowledge of electrical machinery as thorough as possible.

That was about the period which marked the beginning of street railway motor work, or at least when the Edison General Electric Company seriously began the building of street railway motors, and Mr. Ensign was placed in charge of testing in the railway motor department of the works. Here he remained for one year, when he was promoted to the position of chief inspector for the company. Mr. Ensign was the first to hold that position, and to him belongs the credit of organizing the inspection department of the works.

On account of the ill health of members of his family, Mr. Ensign was compelled to resign in 1893 and to move into the more even climate of California. He went to Redlands at once, selecting it as possessing the climate best suited to the needs of his family, and although he arrived there an entire stranger, within a week he found employment with the Redlands Electric Light & Power Company as inspector for the manufacture of the pipe line, which was being built for the original plant of the Redlands Company—the plant which has since become famous for the part which it played in the development of long-distance power transmission in America. Mr. A. W. Decker, who was of all others distinctively the pioneer engineer in electrical transmission work in Southern California, was at that time the electrical engineer of the Redlands Electric Light & Power Company, but as he died before the completion of the plant, Mr. Ensign was chosen to make the final test for the Redlands Company before acceptance. Dr. Louis Bell acted for the General Electric Company in this test, and as it marked the beginning of the first commercial polyphase transmission in the country, Mr. Ensign's experience in transmission engineering dates from the beginning.

This was in September, 1893, and in the summer of 1894 he entered the employ of the Los Angeles Railway Company, after which he started and operated the system of that company in the capacity

of mechanical and electrical superintendent. But his interest in transmission engineering work remained uppermost, and in March, 1896, Mr. Ensign re-entered the employ of the Redlands Electric Light & Power Company as superintendent, just prior to the inception of the project of the Southern California Power Company which later resulted in the epoch-making 33,000-volt, 83-mile transmission from the Santa Ana River to the city of Los Angeles. From first to last Mr. Ensign was the engineer who held the reins guiding this remarkable transmission to its successful outcome.

The property of the Southern California Power Company has since been merged with the properties of the Redlands Electric Light & Power Company and the Edison Electric Company, of Los Angeles, the whole being operated now as the system of the Edison Electric Company, and embracing practically the whole of the great San Gabriel and San Bernardino Valleys, with extensions reaching as far south as Santa Ana. This entire system, embracing almost a continuous stretch of territory running nearly 100 miles east and west by perhaps 30 miles north and south, is now being operated under the direction of Mr. Ensign as its mechanical and electrical engineer and superintendent.

In addition to the cares of administration of his present position, Mr. Ensign is now engrossed in perfecting the engineering details for Mill Creek power house No. 3, a plant of 4000 hp to operate under a 1960-ft. head, after which he will undertake the greater transmission, which his company proposes for the bringing of power into Los Angeles from the Kern River. This contemplates a transmission of some 30,000 hp over lines perhaps 120 miles in length.

The Telephone in Wireless Telegraphy—II.

(Concluded.)

BY EMILE GUARINI.

IN the preceding article various methods of wireless signaling were briefly outlined. We now come to Hertzian waves, the advantages of which in wireless signaling appear to the writer very doubtful. The waves can act directly on a receiver, as indicated in Figs. 23 and 24, or, still better, according to the arrangement shown in Fig. 25. M. Ruhmer, who has continued the writer's experiments, has been able to communicate with similar arrangements and antennæ 100 feet high over 1.2 miles. By means of the receiver of Fig. 23, M. Tommasina has been able (*Comptes Rendus*, Dec. 6, 1901), to follow the course of storms, but at distances evidently less than if a local circuit had been employed, controlled by a coherer.

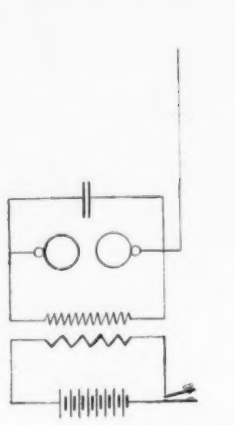


FIG. 23.—SIGNALING BY HERTZIAN WAVES.

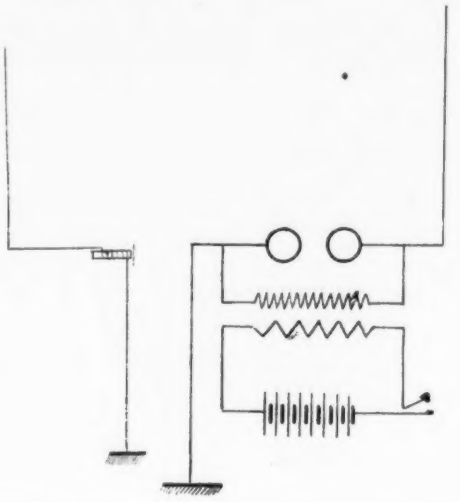
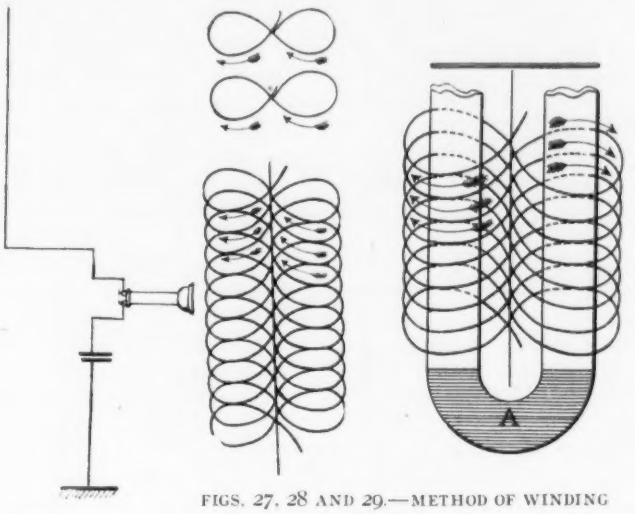


FIG. 24.—SIGNALING BY HERTZIAN WAVES.

It has often been remarked that when the waves exceed a certain frequency, a telephone no longer gives forth sound. This has been explained by ascribing it to excessively rapid changes of polarity of the magnet core. According to my view, if the waves are shorter than the length of the winding of the telephone—which winding they can affect, for example, by induction—there will be in the winding stationary waves with nodes and peaks (Fig. 26). At a given instant there may be in different sections of wire current of different signs, and the resultant may be zero, or negligible with respect to the polarity of the magnet according as the semi-wave lengths are even or odd in number. It is therefore necessary in order not to have opposing effects with at times a zero resultant, to wind the magnet as shown in Figs. 27 and 28. In this latter figure the vertical axis is the line of nodes. In winding the solenoid of Fig. 28 around the core *A*, a telephone for currents of high frequency is obtained such as indicated in Fig. 29.

In optical telegraphy when with the bare eye the distance is too great for sight, a telescope is employed; in ordinary telegraphy when the receiving current is too weak, a relay is employed; similarly, in wireless electrical telegraphy when the waves are too feeble to actuate a telephone, either on account of lack of energy at the transmitter, or on account of the waves being radiated in all directions, recourse is had to an imperfect contact; for what is a coherer or radio-conductor but an imperfect contact? It is a telescope and relay at the same time; a telescope for invisible luminous rays, and a relay of which the sensitiveness is $.1^{14}$ watt.



FIGS. 27, 28 AND 29.—METHOD OF WINDING MAGNET.

The following is a very simple means to apply a telephone in an arrangement which will enable a clear idea to be obtained of an imperfect contact. Following M. Turpain and others, put in circuit (Fig. 30) a circular resonator with a battery and telephone. If by means of an oscillator currents are induced in the resonator, and if the sparking distance at the micrometer indicated is adjusted for a given difference of potential, a spark passes; and as the spark is a conductor, the current of the battery is closed and the telephone gives forth a sound much stronger than if the battery were not present. Mr. Brown in an English patent (Oct. 2, 1899) applies the principle of imperfect contact in still another manner. In circuit (Fig. 31) is a telephone, a battery and a vibrator in imperfect contact with an adjustable point; an electromagnet through which an intermittent current passes, actuates the vibrator, when a feeble sound due to the resistance of the imperfect contact is heard in the telephone. The sound is

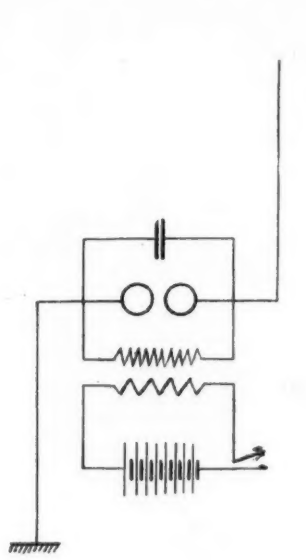


FIG. 25.—RUHMER'S METHOD.

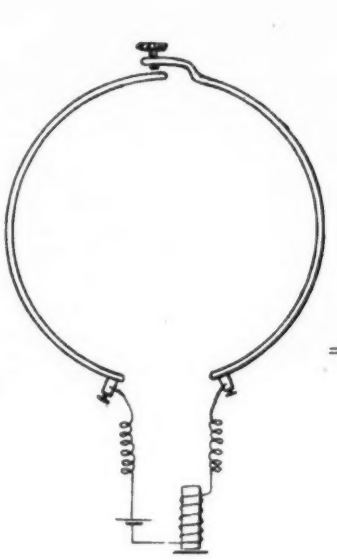


FIG. 30.—TURPAIN'S RESONATOR.

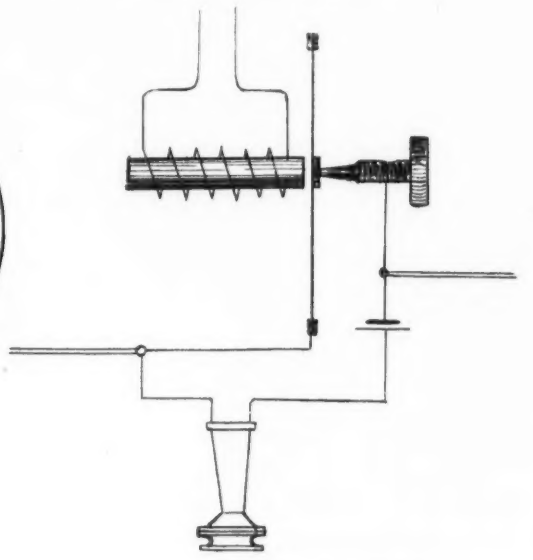


FIG. 31.—BROWN'S METHOD.

strengthened to a very large extent when Hertzian waves strike the imperfect contact and diminish its resistance.

Prof. Blondel, in a sealed communication deposited with the French

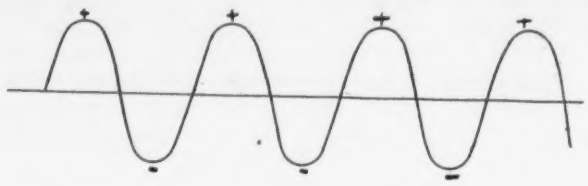


FIG. 26.—STATIONARY WAVES.

Academy of Sciences, Aug. 16, 1898, having the title, "Improvements in Wireless Telegraphy," describes the arrangement indicated in Fig. 32, consisting of a vacuum tube in circuit with a battery and a

On Jan. 5, 1899, M. Tommasina announced to the Societe de Sciences Physiques et Naturelles of Geneva, that he had used the telephone as a substitute for relays. The arrangement which M. Tommasina has since employed is indicated diagrammatically in Fig. 33. It was by means of this arrangement that M. Tommasina was able to follow the course of storms over a radius of 300 miles. In a Belgian patent issued to the writer June 24, 1899, is described the arrangement of Fig. 34. Decoherence was attained by giving to the coherer a continuous motion of rotation. The transmitter employed may be one for Hertzian currents, or that of Fig. 35, which was employed in the writer's Brussels-Malines-Antwerp experiments, described in these columns Aug. 3, 1901.

Mr. A. F. Collins, in an American patent, shows the arrangement of Figs. 36 and 37, where magnetic decoherence is obtained through the employment of an arrangement similar to that described by Lodge

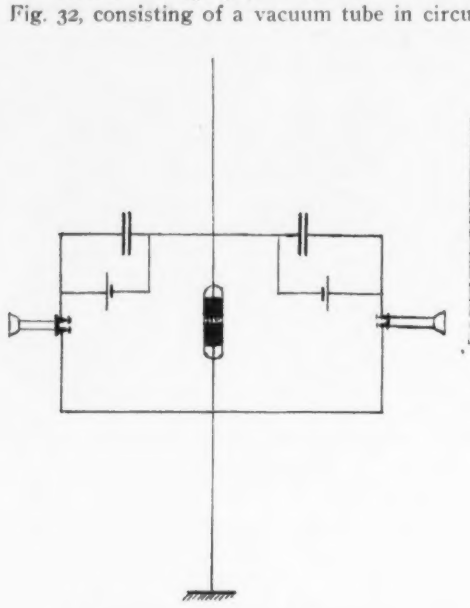


FIG. 32.—BLONDEL'S ARRANGEMENT.

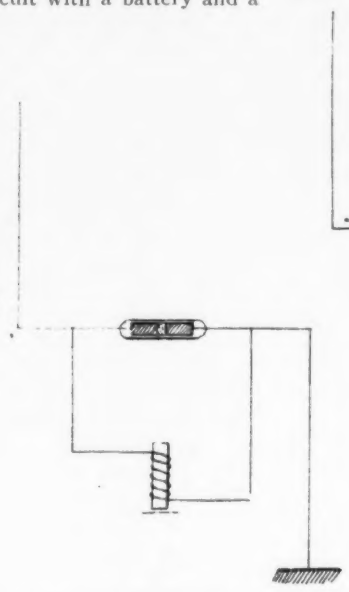


FIG. 33.—TOMMASINA'S METHOD.

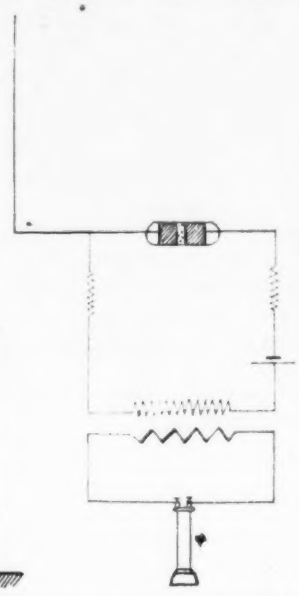


FIG. 34.—GUARINI'S SYSTEM.

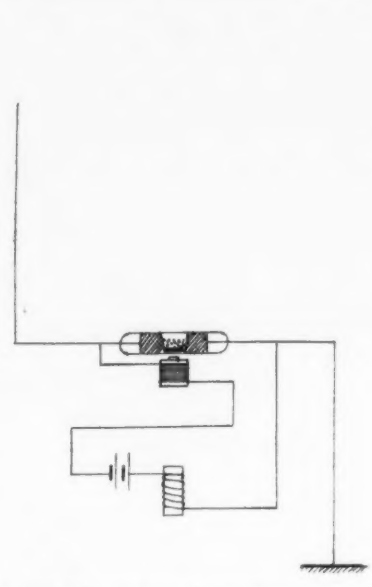


FIG. 36.—COLLINS' ARRANGEMENT.

telephone. In this communication Prof. Blondel also touched upon multiplex signalling and the secrecy of despatches through the use of selective telephones of the Mercadier type, or by means of purely electrical synchronism obtained by means of condensers of proper

and Murhead in 1897, consisting of an electromagnet inserted in the circuit of the battery and coherer.

M. Popoff patented Jan. 22, 1900, the arrangement of Figs. 38 and 39. That of Fig. 38 does not appear to differ from the arrangement

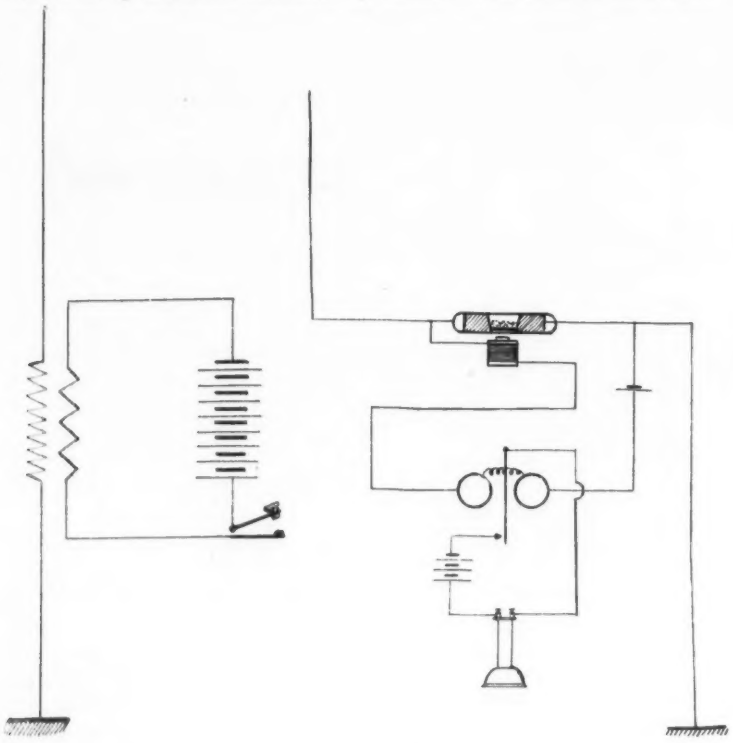


FIG. 35.—GUARINI'S TRANSMITTER. FIG. 37.—COLLINS' ARRANGEMENT.

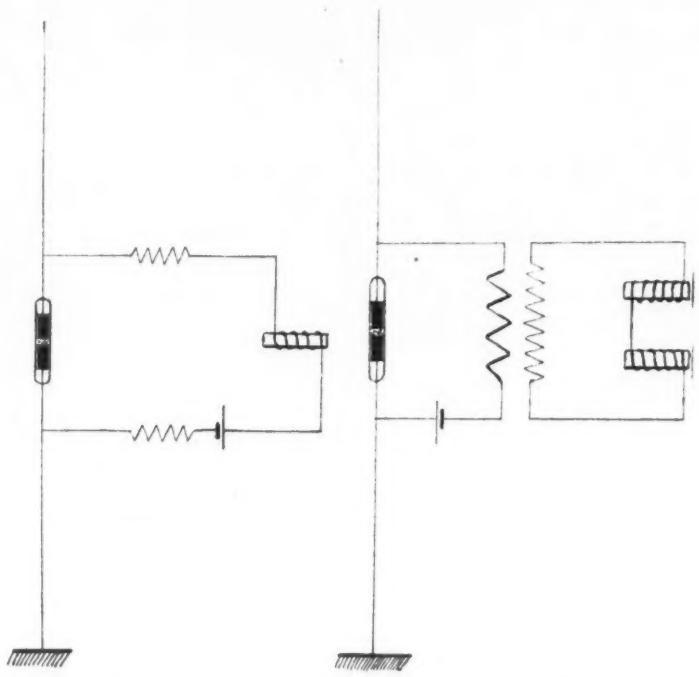


FIG. 38.—POPOFF'S METHOD. FIG. 39.—POPOFF'S METHOD.

capacity. The communication not having been opened until March, 1900, it had no influence on the patents to which we shall refer later on.

of M. Tommasina (Fig. 33) except by the addition of two self-induction coils in the circuit of the coherer, which, however, had previously been done by Marconi. The arrangement of Fig. 39 only differs from

that of the writer by the addition of a ground connection. With the arrangement above described, MM. Popoff and Ducretet were able in Russia and France to signal over a distance which, according to information published, attained 60 miles. In July, 1901, MM. Popp and the Russian Col. Pilsondski, employed at Paris in their experiments between villas at Vesinet over a distance of 1600 feet, the arrangement of Fig. 40. With this arrangement, in which the experimenters claimed that they utilized the earth, the antennæ is replaced by a metallic disk placed on a glass plate resting on the soil. Finally, to complete an enumeration already too long, Marconi in his transatlantic experiments employed a telephone combined with a syntonic "jigger" (Fig. 41).

From the above it will be seen that wireless signalling with a telephone—an excellent receiver from every point of view and very sensitive—can be made practicable in connection with vibrations in the air or water or ether, which in the latter may be vibrations ranging from the very rapid ones of light to electromagnetic waves of low frequency. Ether vibrations which can produce perceptible effects of induction (if, in fact, luminous waves are not electromagnetic waves of very high frequency and therefore ought also to produce inductive effects) can affect the telephone directly or by means of a local battery controlled by a special and very sensitive relay—the imperfect contact. Moreover, the signals transmitted by any one of the four forms of radiant energy—sound, light, heat and electricity—can be reproduced by variations, either at the transmitter or receiver, of each of the three others.

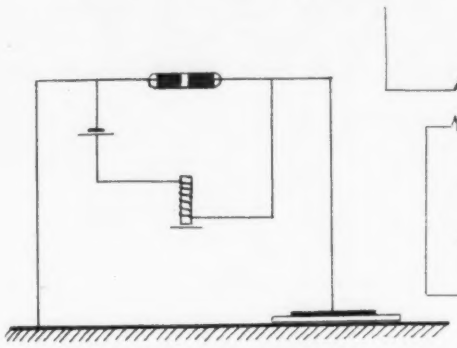


FIG. 40.—POPP AND PILSONDSKI'S ARRANGEMENT.

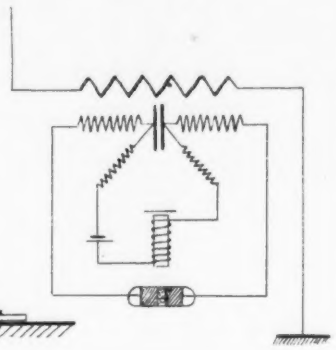


FIG. 41.—MARCONI'S APPARATUS FOR TRANSATLANTIC EXPERIMENTS.

Grounding of High Potential Systems.

By J. D. Nies.

THE present tendency in electrical practice is toward the use of high-potential alternating current, not only for cross-country, power-transmission work, but also for the distribution of electricity for lighting and power in cities. As the number of such installations in operation is already large and constantly increasing, and as these installations moreover are being brought steadily into closer contact with the daily life of larger numbers of people, consideration of them as sources of danger to life and property becomes imperative; in order that the danger, while it is unavoidable to a certain extent, may be kept at its minimum. In what follows the aim is to determine what are the causes to which the existence of danger may be ascribed, with special reference to the occasional practice of grounding the point of zero e. m. f. in such systems.

No definite rule has been laid down as to the advisability of grounding. There has not yet been reached in this matter anything like "standard practice," as, in the field of generator design, is shown by the adoption, after a process of evolution, of certain types as standard. In each individual case the practice adopted has been determined usually by the good judgment or perhaps by the mere personal opinion of the engineers in charge of the installation. The current opinion seems to be that grounding the zero-point is a practice convenient to the central stations, but that it increases the element of danger. The convenience of the practice lies in the fact that grounding the zero-point fixes the potential between conductors and ground, and thereby limits it to a known value, for which proper insulation can be provided, and other safeguards be taken; but it is the current opinion that the very fact that the conductor potentials are thereby maintained at a fixed dangerous value above earth potential, is final evidence that the danger to life is increased by the practice.

For instance, in a three-phase system, grounding the neutral introduces the working Y-voltage of the plant between each phase-wire and ground, and, upon making contact to ground, a contacting body would be subjected to this voltage. On the other hand, if we leave out of present consideration the effect of static capacity (which is too often done in consideration of this matter), any system that is not grounded is entirely free from differences of potential relative to the earth, and can be grounded with impunity through a human body; the passage of an infinitesimal current suffices to discharge the line (a condenser of zero capacity) and the potential of the point touched immediately falls to zero—which means simply a shifting of the potentials of the entire installation relatively to the earth considered as datum. Thus, if capacity were not present, grounding the zero-point would be attended by a real increase in the element of danger; but as a matter of fact, capacity always is present to a greater or less degree, and completely alters the conditions of the problem; owing to capacity, each conductor is, in effect, grounded through a condenser, and, though the conditions are not exactly the same as when one wire is grounded direct, the results are somewhat similar.

The effect of these capacity connections to earth will be to cause the e. m. f.'s of the system to group themselves about the point of zero or earth potential—the common mesh-point of the condensers—which takes the position of a geometrical mean relatively to the system e. m. f.'s. Hence, when the line conductors possess capacity there will exist differences of potential between them and the ground, even when no part of the system is grounded direct. The difference of potential between any given conductor and the ground will not disappear upon connecting it to the ground through resistance (as was noted above to be the case when capacity is not present) for the reason that the capacity acts like an elastic ligament, tending to prevent the displacement of the line e. m. f.'s relative to earth; but the difference of potential will be reduced by the passage of current through the resistance, and if the draught of current be sufficient, may be lowered to a point where it will cease to be dangerous. The action, in each case, depends upon the amount of capacity present in the several conductors, and upon the resistance of the grounding body. Dangerous shocks have been received from alternating-current lines, which were known to be free from grounds, static capacity being generally accepted as the cause. The aim of this investigation is to determine what part is played by capacity in this action, and thus to afford some criterion as to whether the practice of grounding a system increases or decreases danger.

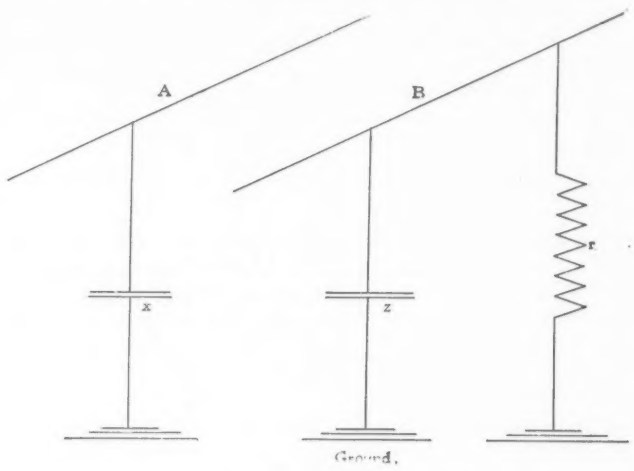


FIG. 1.—SINGLE-PHASE SYSTEM.

Let us first take the single-phase system. In this, as in the other cases to be considered, it is not necessary to take into account capacities measured between line and line, but only those measured between line and ground; the former constitute a local circuit merely, and do not affect the potentials of the lines with reference to external objects. The measurements must be made with all the conductors free from grounds; otherwise the result for any given conductor will be too great by the amount of the capacity existing between it and the grounded conductor or conductors. In the single-phase system, the conditions existing are equivalent to the arrangement shown in Fig. 1, in which x and z are capacity reactances meas-

ured between line and ground, and r is the grounding resistance. This is shown in diagram in Fig. 2, the construction of which is for $r = 1000$ ohms; $a = 2300$ volts; $z = 2000$ ohms; $x = 1800$ ohms.

Current through x

$$I_x = \frac{G\,A}{j\,x}$$

From the figure,

$$G\,A = G\,B - a$$

$$\therefore \quad I_x = \frac{G\,B - a}{j\,x}$$

Current through z

$$I_z = \frac{G\,B}{j\,z}$$

Current through r

$$I_r = \frac{G\,B}{r}$$

The sum of all currents meeting at a mesh-point is zero.

$$\therefore \quad \frac{G\,B - a}{j\,x} + \frac{G\,B}{j\,z} + \frac{G\,B}{r} = 0$$

$$G\,B = \frac{a\,z}{z + x + \frac{j z x}{r}}$$

In absolute quantities

$$G\,B = \frac{a\,z}{\sqrt{(z+x)^2 + \left(\frac{z\,x}{r}\right)^2}} \qquad (1)$$

The equation in complex quantities[1] may be shown to satisfy the vector equation of a circle, the reference point being on the circumference. This equation is

$$\rho^2 - 2\,S\beta\rho = 0$$

in which ρ is the variable vector, and β the vector to the center. The

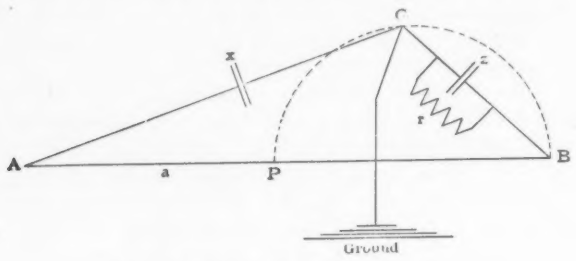


FIG. 2.—GROUNDING RESISTANCE.

vector β is minus one-half the vector to the point G, when there is no ground connection, or when $r = \infty$; and is therefore determined by the equation

$$\beta = -\frac{a z}{2\,(z + x)}$$

The locus of the point G is, therefore, a circle upon the line $B\,P$ as diameter.

From equation (1) by making the numerical substitutions for z, x and a, curves can be platted for any given case, showing variation of $G\,B$ with variation of r. In general, if z and x are fairly small the value of $G\,B$ will be nearly independent of variations of r, until r becomes comparatively quite small. This is illustrated in Fig. 3, where curves are platted for the case $x = z = 1700$ ohms, and a (the voltage of the system) $= 2300$ volts. In this case, a human body, assuming its resistance to be 5000 ohms, would be subjected to a potential of 1083 volts upon making contact between line-wire and ground. This is only 17 volts less than the potential would be if the system were grounded. The difference in favor of the ungrounded system is insignificant; in fact, the advantage in some cases would be reversed, as will be shown later.

Let us next take the three-phase four-wire system. The conditions existing are equivalent to the arrangement shown in Fig. 4. The corresponding diagram is given in Fig. 5, the construction being for $r = 1000$ ohms; $a = 500$ volts; $b = 500\sqrt{3}$ volts; $x = 2300$ ohms; $y = 1800$ ohms; $z = 2500$ ohms; $w = 2000$ ohms; Y-voltage equals 1000.

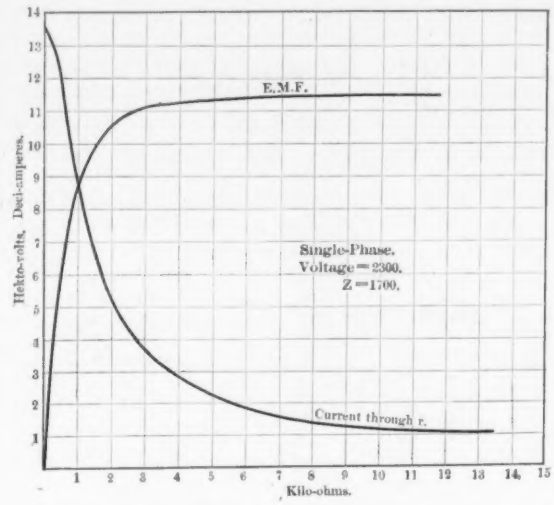


FIG. 3.—VARIATION CURVES.

Let us take $2a$ = Y-voltage.

$$N\,A = 2\,a$$

$$N\,B = -a + jb$$

$$N\,C = -a - jb$$

Current through r and z

$$I_c = G\,C\left(\frac{r + jz}{jrz}\right)$$

Current through w

$$I_n = \frac{G\,N}{jw}$$

$$G\,N = G\,C + a - jb$$

$$\therefore \quad I_n = \frac{G\,C + a + jb}{jw}$$

Current through y

$$I_b = \frac{G\,B}{jy}$$

$$G\,B = G\,C + 2jb$$

$$\therefore \quad I_b = \frac{G\,C + 2jb}{jy}$$

Current through x

$$I_a = \frac{G\,A}{jx}$$

$$G\,A = G\,C + 3\,a - jb$$

$$\therefore \quad I_a = \frac{G\,C + 3a + jb}{jx}$$

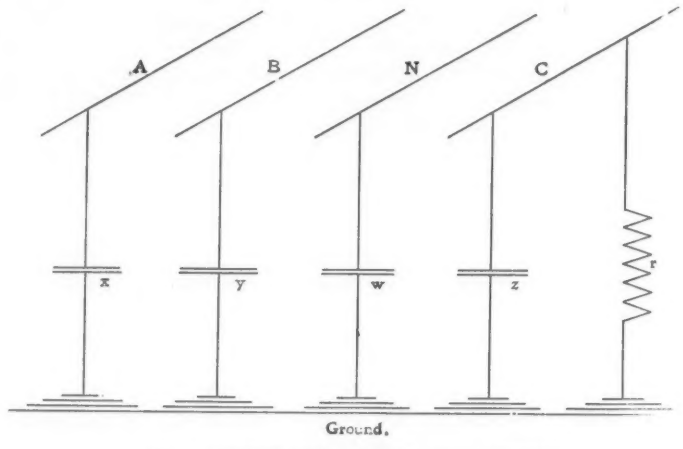


FIG. 4.—THREE-PHASE, FOUR-WIRE SYSTEM.

The sum of all currents meeting at a mesh-point is zero

$$\therefore \quad I_a + I_b + I_c + I_n = 0$$

Adding the expressions obtained above for these currents, and re-

[1] It must be noted that the equation is not, strictly, a vector equation. In any expression in complex quantities, as $r = a + jb$, the second member is not a vector, but a quaternion, giving the value of r in terms of a unit vector along the reference line $A\,B$. This unit vector is k in the system of quadrantal versors i, j, k, in which j is the unit vector at right angles to the plane. Hence the equation should be written

$\frac{r}{k} = a + jb$, or $r = (a + jb)\,k = ka + ib$; or, in other words, the factor k must be introduced before the vector formulæ can be applied. In this particular case (Fig. 2) the multiplication into k is unnecessary, since the radius of the locus-circle and the line of reference are coincident.

ducing, we get an expression for the potential upon a grounding body,

$$G\,C = -z\left[\frac{ay\,(x+3w)+jb\,(xy+wy+2wx)}{wyx+zyx+wyz+wxz+j\frac{wxyz}{r}}\right]$$

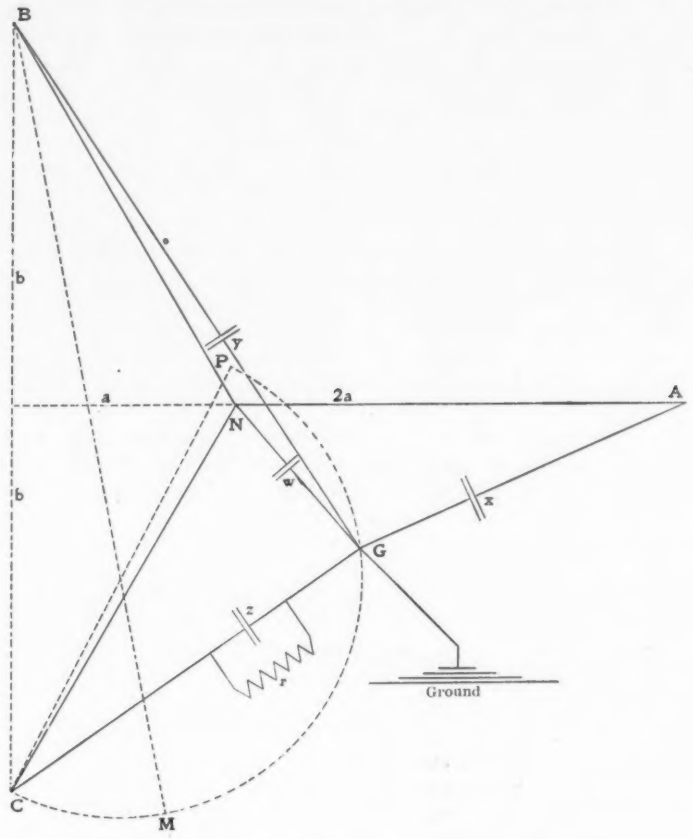


FIG. 5.—DIAGRAMS OF THREE-PHASE FOUR-WIRE SYSTEM.

Replacing by constants

$$G\,C = -\frac{k+jl}{m+j\frac{n}{r}}$$

$$tan\,\omega = \frac{lm - k\frac{n}{r}}{km + l\frac{n}{r}}$$

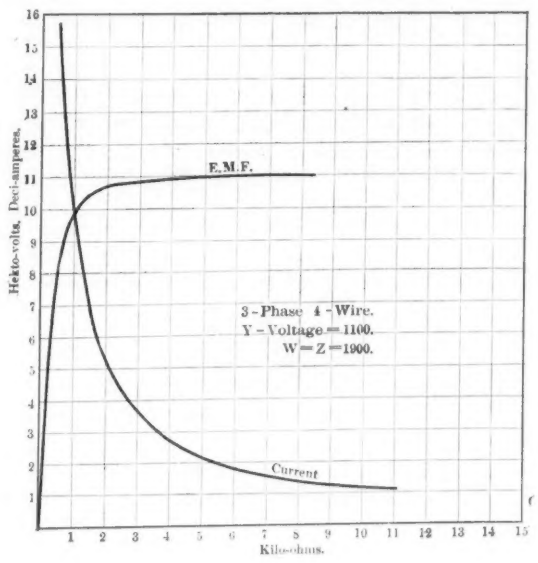


FIG. 6.—CURVES THREE-PHASE, FOUR-WIRE SYSTEM.

In absolute quantities

$$G\,C = z\sqrt{\frac{a^2y^2\,(x+3w)^2+b^2\,(xy+wy+2wx)^2}{(wyx+xyz+wyz+wxz)^2+\left(\frac{wxyz}{r}\right)^2}} \qquad (2)$$

If $x=y=z$

$$G\,C = \frac{(Y\text{—voltage})}{\sqrt{1+\left(\frac{wz}{r(3w+z)}\right)^2}} \qquad (3)$$

If $w=x=y=z$

$$G\,C = \frac{(Y\text{—voltage})}{\sqrt{1+\left(\frac{z}{4r}\right)^2}} \qquad (4)$$

By a proof similar to that used in the preceding case, it may be shown that the locus of the point G is a circle upon $C\,P$ as diameter; the vector $C\,P$ is the vector from C to the point of zero potential

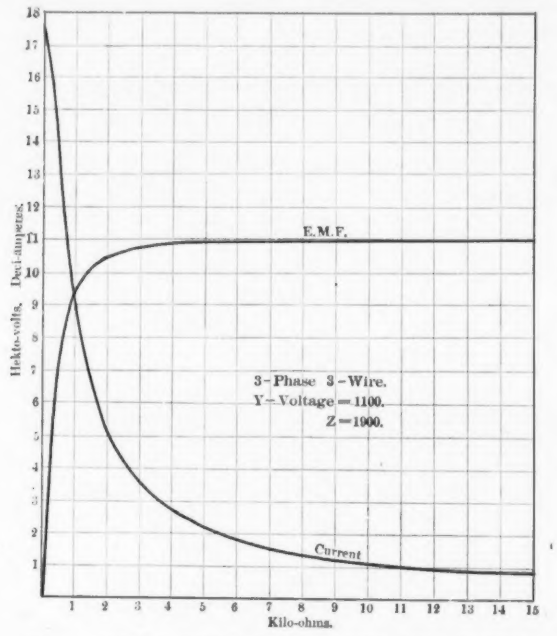


FIG 7.—CURVES, THREE-PHASE, THREE-WIRE SYSTEM.

when there is no connection to ground, and is, therefore, determined by putting $r=\infty$ in the above equations.

As in the preceding case, if there is a fair amount of capacity present in the system, the potential $G\,C$ will undergo a very slow decrease as r decreases, until r becomes relatively very small. As an example, curves are platted in Fig. 6 for the case where $x=y=z=w=1900$ ohms, and the Y — voltage is 1100. As there shown, a human body, assuming its resistance to be 5000 ohms, would be subjected upon making connection between phase-wire and ground to a potential of

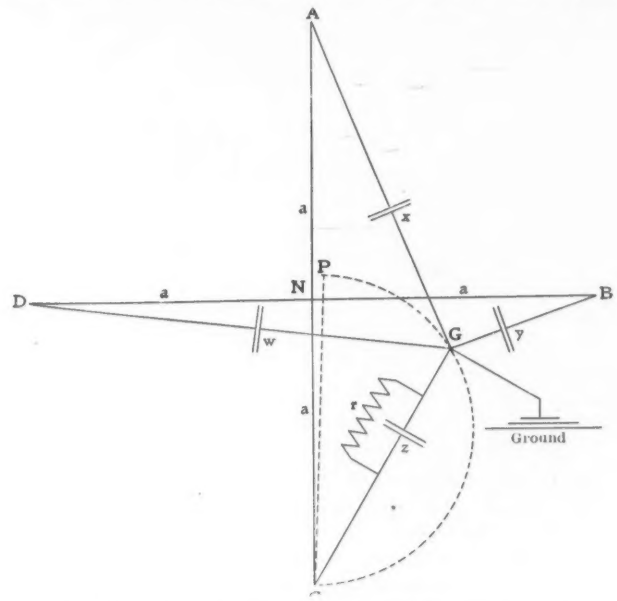


FIG. 8.—DIAGRAM OF TWO-PHASE, FOUR-WIRE SYSTEM.

1095 volts, which is only 5 volts less than the corresponding value in the same system grounded at the neutral. This difference in favor of the ungrounded system is insignificant. To reduce the potential $G\,C$ below a dangerous value, would require that the resistance of the grounding body be not more than 500 ohms; the current through this

resistance would be about 1.5 amperes. It is evident that, in this system, grounding the neutral point would not appreciably increase danger.

Let us next take the three-phase three-wire system. This is a special case of the preceding, in which there is no neutral wire; by substituting $w = \infty$ in (12), an expression for the potential upon a grounding body is obtained. (The notation is the same as in the preceding case.)

$$G\,C = z\sqrt{\frac{9a^2y^2 + b^2\,(y + 2x)^2}{(xy + xz + yz)^2 + \left(\frac{xyz}{r}\right)^2}} \qquad (5)$$

The locus of G is a circle, as before. If $x = y = z$

$$G\,C = \frac{(Y - \text{voltage})}{\sqrt{1 + \left(\frac{z}{3r}\right)^2}} \qquad (6)$$

Curves are given in Fig. 7 for the case where $x = y = z = 1900$ ohms, and the Y — voltage is 1100. The remarks made on the preceding case apply here also.

Let us next take the two-phase four-wire system. The diagram for this system is given in Fig. 8, the construction of which is for $r = 1000$

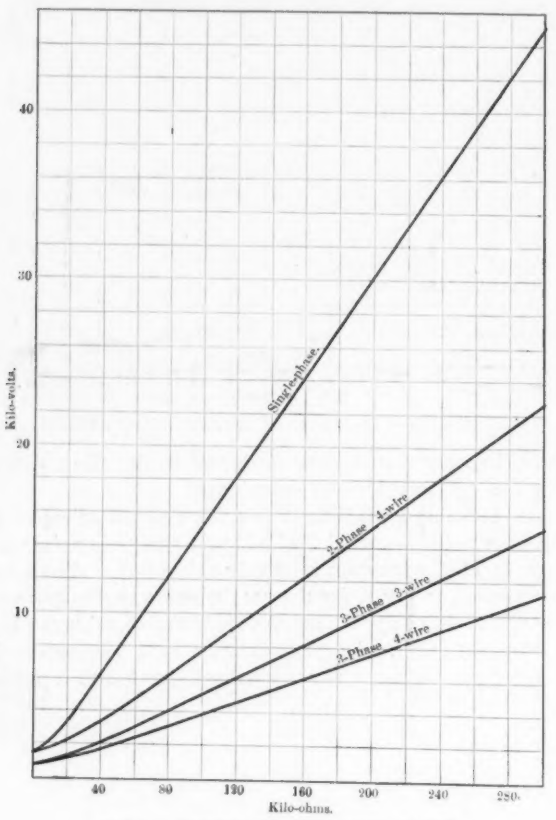


FIG 9.—CURVES FOR THE FOUR CASES.

ohms; $a = 1000$ volts; $z = 2700$ ohms; $y = 2000$ ohms; $x = 1800$ ohms; $w = 2300$ ohms.

Employing the same methods as that used in the preceding cases, we get an expression for the potential upon a grounding body.

$$G\,C = az\sqrt{\frac{(zy - wx)^2 + (xw + xy + 2wy)^2}{(wxy + wxz + wyz + xyz)^2 + \left(\frac{wxyz}{r}\right)^2}} \qquad (7)$$

If $w = x = y = z$

$$G\,C = \frac{a}{\sqrt{1 + \left(\frac{z}{4r}\right)^2}} \qquad (8)$$

where a is one-half the potential between opposite conductors. The locus of G is a circle, as in the preceding cases. These equations are similar to those obtained for the three-phase system, and the curves in Fig. 6 may be taken as typical for this case.

In the numerical cases considered above, the voltages assumed were all comparatively low, while the values of capacity assumed were such as are known to occur in existing installations. If higher voltages were assumed, and the cases worked out, the conclusion would be still more obvious that static capacity between line-wires and ground must usually be regarded as a source of danger. In the cases considered, the danger caused by capacity is seen to be fully as great as that caused by grounding. Under a slight modification of the conditions it will be greater. This occurs when the capacities of the line conductors are not equal, resulting in an unsymmetrical distribution of potential about the zero-point. This may be seen in Figs. 2, 5 and 8. In this case the potential impressed upon a grounding body might be higher than the Y — voltage, to which value it would be limited in a grounded system. Therefore, in certain cases the practice of grounding not only does not increase danger, but may actually reduce it.

The equations deduced above for the potential impressed upon a grounding body are all of the form

$$G\,C = f(a, z, r)$$

where a is the line voltage, z the capacity-reactance between conductors and ground, and r the resistance of the body through which the ground is made. This is the general equation; but if we wish to limit the discussion to the particular case where the resistance r is that of the human body, and can assign to $G\,C$ some value as the lowest limit of potentials dangerous to human life, we can get equations between z and a of the form

$$a = f(z).$$

These equations will give, for any system of voltage a, the (approximate) highest value of capacity-reactance (the lowest value of capacity) which will bring about in that system the condition of danger to human life. Curves for the four cases considered are platted in Fig. 9, from equations derived from (1), (4), (6) and (8), by assuming the resistance of the human body to be 5000 ohms, and the lowest dangerous potential to be 750 volts. In these curves the abscissæ are reactances; the ordinates are Y — voltages for the three-phase systems. and voltages between opposite conductors for the single-phase and two-phase systems. These curves show that static capacity between lines and ground, even though present in very slight amount, is to be regarded as a source of danger, especially in high-voltage systems.

Viewing the matter from another standpoint, that of securing maximum reliability in operation, we find that, in most cases, there are decided advantages in grounding the zero-point. In the first place, the practice secures the immediate detection of faults, and necessitates their immediate removal. Also, when the zero-point is grounded, the potentials between conductors and ground are thereby limited to a definite amount, namely, the Y — voltage; but no such limit is imposed in an ungrounded system. The potentials between phase-wires and ground may vary between wide limits, and may rise to such values as would seriously increase the liability of breakdown of the line insulation. For instance, referring to the numerical case diagrammed in Fig. 5, it is seen that the maximum potential produced between the wire B and the ground, by the presence of a ground on the wire C, would be 1830 volts. In a grounded system this potential would have been limited to 1000, the Y — voltage; here it is higher than the delta-voltage of the system. The increase is 83 per cent. Such a rise of pressure, taking place in a high-voltage system, would very greatly increase the danger of breakdown, as well as danger to human life. This, of course, is an extreme case; but the effect is always present to a certain extent, and may at any time occur in the extreme degree.

As a conclusion it may be stated, that the practice of grounding high-potential system conduces, in most cases, to reliability in operation, and that, with rare and unimportant exceptions, it cannot be objected to on the score of causing increased danger to life and property.

Another Wireless Telegraph Station.

It is announced that the American Wireless Telegraph & Telephone Company has begun the construction of a tower at the Highlands of Navesink for the reception of messages from incoming steamers. It is the company's intention to report incoming vessels in opposition to the Marconi company. The tower will be 130 feet high Its location is the highest pointand will have a base 40 feet square. on the coast south of Maine, being 210 feet above the sea level. The American Company intends to erect towers at Fire Island and Montauk Point. Another important feature of the work will be the sending of wireless telephone messages along the Jersey and Long Island coasts, and ultimately from Maine to the Carolinas. The original intention was to build a 150-foot tower at the Highlands of Navesink, but builders said this height was too great to withstand successfully high winds. It is said a half dozen old pilot boats or other craft will be hired to stand out to sea and report by wireless telegraph the names of ships approaching the American coast.

The Storage Battery in the Commercial Operation of Electric Automobiles.

By W. H. Palmer, Jr.,

IN discussing the merits of the various systems of automobile propulsion, the electrically-driven vehicle is too frequently dismissed with the arbitrary statement that, although ideal in so far as motor, controlling mechanism, etc., are concerned, it is rendered impracticable for commercial use by reason of the great weight of the necessary storage battery, its unreliability, and the great amount of attention which it demands. On the other hand, there are not lacking those who maintain that, thanks to the unremitting efforts of the past few years, the storage battery is, in the special types furnished for automobile work, freed to a great extent from those objections.

Attempts have been made, from time to time, to collect and publish results obtained by isolated users of electric vehicles, but, as is also true of similar data collected concerning other systems of automobile propulsion, the reports have been so contradictory, and improper conditions so large a factor, that the information so obtained has been of little value.

The greater the scale on which operation is conducted, and the more perfect the knowledge of the conditions surrounding it, the more accurate and interesting should be the conclusions drawn therefrom.

Electric cab service in New York City was inaugurated in the spring of 1897 by the Electric Carriage & Wagon Company, with an equipment of twelve hansoms and one surrey. To-day that service, conducted by the New York Transportation Company, has grown to such proportions that upwards of three hundred vehicles are in daily operation, running an average of nearly five thousand cab miles per day. That the service performed by these vehicles is successful, from the point of view of the patrons, is shown by the fact that, at rates equal to, or in excess of the rates charged for the highest class of horse livery service, far more applications for service are received daily than the company, even with its increased equipment, is able to accept.

This growth would seem to indicate that, by this company at least, solutions have been found for the various problems encountered—that of the storage battery among the rest. It is the object of this article to describe briefly the progress that has been made along this line, and the means that have been employed to obtain economy and reliability of operation. While vehicles of nearly every description are included in the equipment, the operation of hansoms and broughams constitutes the greater portion of the company's business, and the portion upon which accurate figures are most easily obtainable, and the statements which follow have been based upon the vehicles and batteries used in that service.

About one and a half batteries are kept in commission for each vehicle operated. This number is sufficient to meet the requirements of service calling for the use of vehicles at all hours, both day and night. Of these, about two-thirds are, at present, of the "Chloride-Manchester" type, and one-third of the "Exide" type—both the product of the Electric Storage Battery Company—one or the other being used according to the nature of the work to be done by the vehicle. No batteries of any other type are used by this company. Tests have been made of the other types of automobile cells which have from time to time made their appearance, but none have promised or performed so well as those now in use.

It is of great importance that the batteries used should be the product of manufacturers who can be depended upon to supply promptly and certainly such parts as may be necessary for increases, renewals and replacements. An unvarying standard of quality is also a prime consideration. The characteristics inherent in the batteries in use, which particularly adapt them to the service required, will be spoken of later.

The Chloride-Manchester elements are so well known that a detailed description of them should be unnecessary. The standard brougham or hansom battery of this type consists of 44 cells having three Manchester positive and four Chloride negative plates. The weight of the battery complete in the tray, with all connecting straps, etc., is 1790 lbs., and the capacity 108 ampere hours at the three-hour rate of 36 amperes.

These batteries, as originally furnished, were assembled with corrugated perforated hard rubber separators between the plates. These separators were unsatisfactory for various reasons. One of the principal sources of trouble was in the tendency of these separators to flatten out if, during the hot weather of the summer months the batteries, for any reason, became slightly overheated. The flattened portions would then form pockets in which the active material, which is always slowly being thrown off from the surfaces of the plates, would collect, quickly causing partial short-ciruits, leading to "dead" or "weak" cells, and, if neglected, to more serious trouble, if not the total loss of the plates. This was partly overcome by employing a "heat-proof separator," which, being corrugated before being vulcanized, was much less apt to flatten. These were, however, still unsatisfactory. To economize space, the distance between adjacent plates in the cells is necessarily small, and particles of active material frequently lodged in the perforations, forming the nucleus of bridges which gradually built themselves across from plate to plate; or, in assembling or repairing the cells, a careless workman might allow a quantity of lead, melted under the hydrogen flame, to run down between the plates, which, rivetting in the separator perforations, would eventually cause a partial short circuit, at once difficult to detect and remove. Moreover, the first cost of the separators was great, and, being brittle, many were broken in the operation of cleaning and repairing the cells, constituting a constant source of annoyance and expense.

The Electric Storage Battery Company, therefore, set itself the task of providing a substitute for this expensive and unsatisfactory separator, and about a year ago brought out a grooved wood separator, without perforations, which is now used in all batteries of this type,

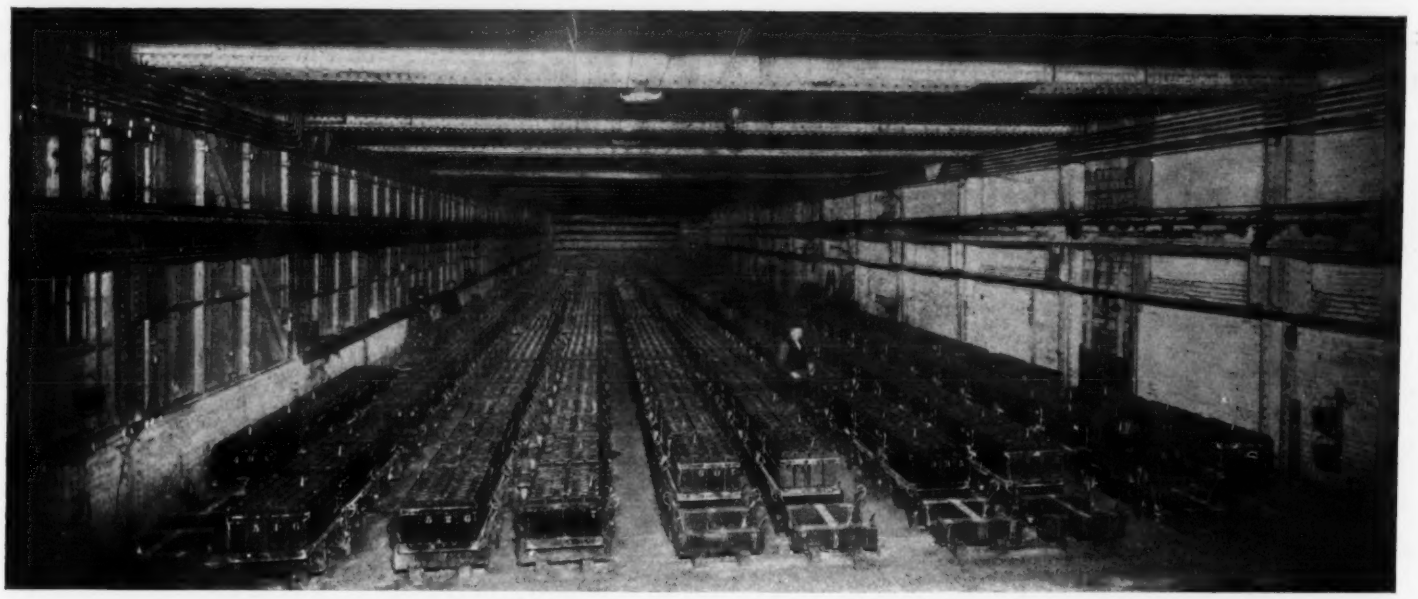


Fig. 1.—Battery Charging Room, New York City.

and which is free from all of the above objections. These separators are ⅛-inch thick, with vertical grooves, 3/64-inch deep, on both sides. The distance between centres of grooves is ¼-inch. The width of the separators is equal to, and the height ½-inch greater than the corresponding dimensions of the plates. Being without perforations, they form practically a continuous diaphragm between the plates.

Partial short-circuits are almost entirely prevented, and, in the rare cases where they do occur, can be readily removed. Cleaning is necessary at less frequent intervals, and the life and capacity of the elements are therefore conserved and the efficiency increased. The first cost of these separators is small, and with a life of from 3000 to 5000 miles the maintenance cost is very low. These separators do not increase the internal resistance of the cells.

Connection between the battery and vehicle wiring is made by means of copper terminal plates mounted upon the sides of the tray. On the sides of the battery compartment in the vehicle are spring-mounted contact-blocks, which have pressure contact with the plates on the tray when the battery is in position in the vehicle.

The 44 cells comprising a battery are connected in one series. This is a decided improvement upon former practice, when two, and even four series were the rule. The advantage is that only two contacts are required for the single series as compared with four or eight with the two and four series arrangements. These contacts, consisting of flat plates having upwardly extending lugs, are securely fastened to the sides of the tray. The lugs extend to within a few inches of the terminal cells of the series, to which they are attached

FIG. 2.—STANDARD EXIDE BATTERY FOR HANSOM OR BROUGHAM.

by short solid copper wires. With the two and four series arrangements, the contacts and wires were a source of much trouble. With the two contacts and short stout wires, such troubles are rare.

The weight of a standard brougham, with battery, driver and two passengers, is about 5300 lbs. Such a vehicle, when in good condition, will consume, at the normal running speed, on level asphalt, about 50 watt hours per 1000 lbs. per mile, or 265 watt hours per vehicle mile. This will be increased if the vehicle is not in good order, if the retardations, because of traffic, are very numerous, or if the streets traveled over are rough or covered with mud or snow. A fair average for reasonably clear streets has been found to be 60 watt hours per 1000 lbs. per mile, or 318 watt hours per vehicle mile.

The capacity of the battery at the three-hour rate is, as stated, 108 ampere hours. As the average voltage of discharge of 44 cells at this rate is about 84 volts, the watt hour capacity is about 9072 watt hours.

The mileage capacity under average conditions will, therefore, be 28.5 miles. The weight, and consequently the power consumption, of the hansom are slightly below these figures, but the difference is not great. The radius of action indicated by these figures is ample for the bulk of the service which vehicles are called upon to perform in and about New York. It is necessary, however, to allow a relatively high margin of safety to insure reliability, since imperfections in the vehicle, a battery not fully charged, or snow-covered streets, may materially reduce the mileage capacity. In order, therefore, to care for service requiring greater mileage on a single charge than could be secured from the Chloride-Manchester cells, and also to increase the margin of safety, the Electric Storage Battery Company was asked to submit for trial a battery of higher capacity.

Having anticipated this demand, the manufacturers had for some time been engaged in exhaustive tests of various types and forms of plates, and, as the result of this work, the first battery of the Exide type was furnished in the fall of 1900. This battery constitutes a signal advance in the art of storage battery construction. Presenting to the casual view no distinctly new features, it nevertheless embodies principles never before brought together and which combine to secure, in a greater degree than has hitherto been obtained, the three necessary features of a commercially successful automobile battery—high capacity, long life, and, if the phrase be pardonable, a strong constitution; that is to say, freedom from structural weakness and the ability to withstand, without serious injury, a great deal of neglect and abuse. The advent of this battery has given to the electric automobile industry a renewed impetus. As it is a comparatively recent development, a somewhat particular description of its construction and capabilities should be of interest.

The plates are of what is generally known as the pasted, or Faure type, consisting of antimonious lead grids or supports pasted with oxides of lead. Both theory and the results of many years of experience have shown that, just as the chemical changes undergone by the active material of the positive plate in the operations of charging and discharging differ from those undergone by that of the negative plate, so, in order to secure the best results, the distribution and mode of supporting the active material of the one should differ from those of the other. This principle has been recognized in the design of the Exide battery as it has not been in any previous form of the pasted type of cell. In previous forms both positives and negatives have been of the same general construction; in the Exide battery they are radically different, that construction having been adopted for each, which experience has proved to be the best.

The negative plate consists of a grid made of an antimonious lead sheet, around which a frame of sufficient weight to secure the necessary stiffness and strength has been cast. The body of the sheet is filled with perforations, evenly spaced at small intervals. These are made by a tool which does not remove any material, but instead tears its way through, leaving numerous small clawlike projections around each hole, which are curved back toward the sheet, forming a series of hooks. Half of the perforations are made from one side and half from the other, so that after the operation is completed both sides are thickly studded with these little hooks.

Both sides of this grid are then pasted with litharge. The paste is held to the grid by the little hooks and is also rivetted through the perforations, giving all portions of the mass a tenacious hold upon the support, and upon each other. There are no isolated pellets to shrink and drop out, no large masses pasted against a flat surface to scale off, and but little of the support exposed, leaving the whole of the faces of the plates active and giving a maximum rate of discharge per unit of area. The distribution of the mass of active material is nearly ideal. Being applied in a thin layer, all parts of it are close to the current carrying support and in a position to give maximum capacity per unit of mass. The thickness of the finished plate is 3/16-inch.

The grid of the positive plate is of the "cage" type, consisting of thin vertical ribs, the edges of which are flush with the faces of the plate, and which are connected by small bars having a triangular cross-section, the base of the triangle being at the face of the plate. These connecting bars on one face are staggered with those on the other. This grid is pasted with red lead and formed in the usual way, the thickness of the finished plate being 7/32-inch. The active material is in the form of continuous pencils, of rectangular cross-section, extending from the top to the bottom of the plate. The thin flat ribs are on two sides of the pencils and the triangular cross-bars are embedded in the other two sides, which constitute the faces of the plate. The design of the grid gives a maximum of strength and stiffness with a minimum of weight. The continuity of the material combined with the cross-bars holds it firmly in place, while at the same time provision is made for its expansion and contraction. In service the active material is gradually eroded from the surfaces. The bars, being embedded in the material, contact is maintained until the amount of active material is so reduced as to no longer be sufficient to give the proper capacity. The separation of the faces of the plate into relatively small sections by the ribs and bars prevents the rapid removal of the active material by the "wash" of the electrolyte.

The separators used in these cells are of wood and similar to those used in the Chloride-Manchester batteries. A plain perforated hard rubber sheet is also placed against each face of the positive plates.

The standard brougham or hansom battery of the Exide type consists of 44 cells of the T V-9 size, having four positive and five negative plates. The rubber jar is the same as that used for the T V-7 Chloride-Manchester cell, and the batteries are assembled in trays of the same size, making the two types of battery interchangeable in the vehicle. The weight of this battery complete with tray, etc., is 1650 lbs., or 140 lbs. less than that of the Chloride-Manchester type.

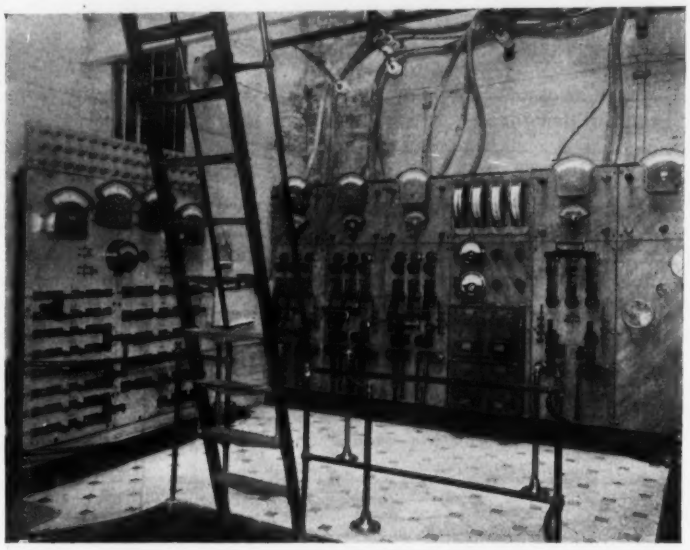


FIG. 3.—ROTARY CONVERTER SWITCHBOARD.

The capacity is 156 ampere hours at the 4-hour rate of 39 amperes. The average voltage during discharge is 87 volts; the watt hour capacity, therefore, is 13,572 watt hours, an increase of 50 per cent over that of the Chloride-Manchester batteries and of 62.5 per cent per pound. Using the figures for average vehicle consumption already given, the mileage capacity will be, under average conditions, 42.7 miles.

In connection with the general subject of mileage capacity, it should be noted that the mere statement that a certain vehicle equipped with a certain battery has run a certain number of miles on a single charge, is valueless unless accompanied by additional data concerning the relative weights of vehicle and battery, the load carried, the power consumption per mile, the speed, etc. Nor does the attainment of a high mileage capacity necessarily imply commercially successful operation. Increase in radius of action on a single charge may be obtained in three ways, by increasing the proportionate weight of the battery; by decreasing the power consumption per unit of weight per mile; or by increasing the effective capacity per pound of battery. Ill-considered steps in any of these directions may easily result in an increased maintenance cost which will far outweigh the advantages of increased mileage capacity. No reliance should be placed on any statements in which full details of the attendant conditions are not included.

The battery policy of the New York Transportation Company necessarily depends very largely upon the question of cost of operation per vehicle mile. It has, therefore, been most gratifying to find, after a year of operation, that the Exide battery not only provides a sufficient mileage capacity for all classes of metropolitan service, but at the same time can be operated at a cost, including maintenance, but little in excess of that of the Chloride-Manchester and within the limits of reasonable expense. This conclusion is based upon the results obtained from 75 batteries, which have been in continuous service for about one year.

In calculating the battery expense per vehicle mile the cost is divided under two general heads, "Operation" and "Maintenance." The latter is sub-divided into "Renewals," "Cleaning" and "Repairs." In the cost of "Operation" are included the expense for current and labor used in charging and handling the batteries, and also of the acid and labor used in regulating and replenishing the electrolyte. All batteries are removed from the vehicles for charging. This is done both to facilitate inspection and to avoid the loss of time and the other complications that would result from having the vehicle lie idle during the charging period. The batteries are handled entirely by machinery. The equipment provided for this purpose has been very fully described in previous articles. Labor is thus reduced to a very low figure. Current for charging purposes is taken direct from the high tension alternating mains of the New York Edison Company, at 6600 volts, 25 cycles. This is transformed and converted to direct current at pressures from 98 to 110 volts. The equipment of static transformers, rotary converters, etc., necessary to accomplish this is owned and operated by the Transportation Company. The capacity of this installation is 800 kilowatts. Four sets of large, stationary storage battery cells are also included in the equipment, being used as booster and crusher batteries to secure a number of bus pressures from a single rotary converter.

Four bus pressures are provided at the charging switchboard, being 98, 102, 106 and 110 volts respectively. The batteries are put in charge on the lowest and moved up as the current falls until the highest bus is reached. When the current taken on this bus falls to a value depending somewhat upon local conditions, but which averages 10 amperes for Chloride-Manchester and 7 amperes for Exide batteries, the charge is complete and they are cut out. The batteries, being kept in good condition, can stand fully charged for 24 hours without appreciable loss of charge, the loss in the course of a week being only about 10 per cent. By careful attention to this portion of the work, and by keeping the batteries in an efficient condition, a very fair degree of efficiency between the charging switchboard and the vehicle motors has been attained, the figure being about 50 per cent watt efficiency, which, considering the high rates of charge and discharge, and the loss of efficiency by operation on partial discharges, as will be explained later, is very creditable. The charging of all of the batteries is controlled from a single central switchboard. Under the system adopted, this portion of the work is so simplified that even during the hours when the greatest number of batteries are being charged, one boy is able to handle the entire board.

The specific gravity of the electrolyte of the Chloride-Manchester

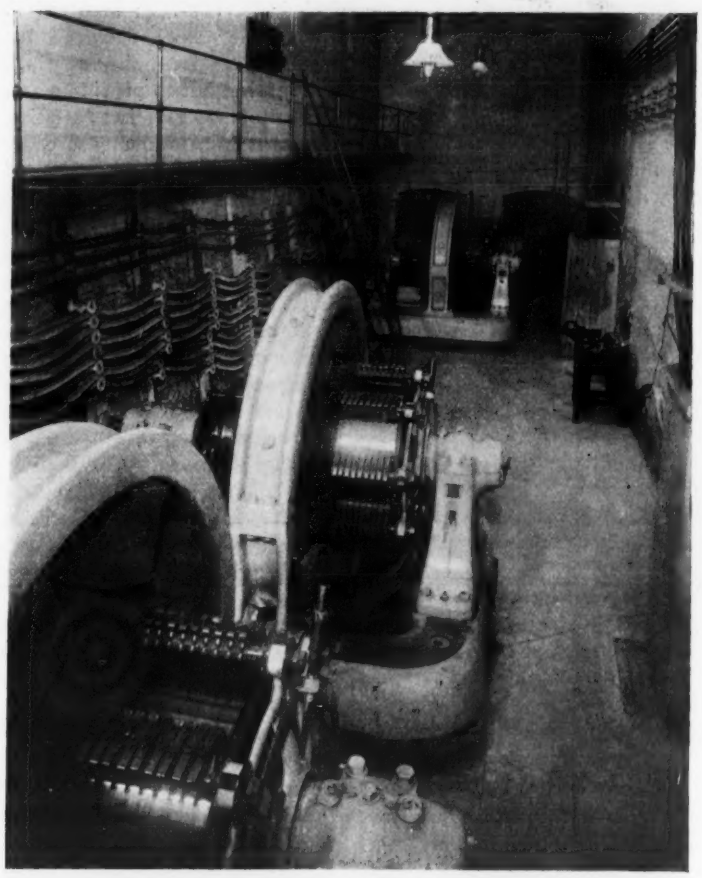


FIG. 4.—THE FOUR 200-KW ROTARY CONVERTERS.

batteries is 1.250 when the cells are fully charged, and that of the Exide batteries is 1.300. The maintaining of the density of the solution at the proper point and the replacing, with water distilled on the premises, of the loss by evaporation is very important. This work is in the hands of specially trained men.

Maintenance includes, under the sub-head of "Renewals," the cost of plates, separators and incidental supplies used in maintaining the

integrity of the equipment. The most accurate figures on the cost of renewals are based on the life of the plates, etc., in vehicle miles. This will, of course, depend greatly upon the conditions of service. The greater the mileage made on each charge, the longer will be the life, other things being equal; an Exide battery which had made 1480 miles on 40 charges, or an average of 37 miles per charge, showed no more deterioration than one which had made but 1040 miles on the same number of charges, or an average of only 26 miles per charge.

The average mileage per charge made by the Exide batteries in regular service is only 20 miles. The necessity of sending out every vehicle each morning, with ample power to meet the extreme possible requirement of every customer, makes it difficult to increase this average, although the cost of renewal would be decreased could it be done. The operation of batteries on partial discharges also means a reduced efficiency, as mentioned above. The reason for this will become evident from a consideration of the following, taking, for instance, an Exide battery having a capacity of 13,572 watt hours. If the watt efficiency on full discharges be taken as 75 per cent, the charge after a full discharge will amount to 18,096 watt hours, or an excess of 4524 watt hours. If, however, only one-third of the capacity be taken out, or 4524 watt hours, it will still be necessary, in order to fully charge the battery, to give an excess charge very nearly as great as in the former case, or, say, 4200 watt hours, making a total of 8724 watt hours, or an efficiency of only 52 per cent.

The private owner of an electric vehicle has, for these reasons, a decided advantage over a company renting them, as, knowing in advance the service required, he can operate his battery up to a much higher average mileage per charge, increasing its life and efficiency.

The 75 Exide batteries placed in service by the New York Transportation Company nearly a year ago, had made, up to Feb. 1, 1902, an average of 3742 miles each. Seven of them had made over 4500 each, the maximum being 4958 miles. Thirteen of these 75 batteries had been retired from service up to Feb. 1. Two of these were withdrawn from service because of their having been involved in accidents, in which a number of the plates were damaged beyond repair. The others have been withdrawn from time to time, not because they were unfit for further service, but to provide plates for necessary renewals and replacements in the remaining batteries. The idea has been to treat these 75 sets as a unit, gradually weeding out the plates which, through accident or use, fall below the rated capacity, and in this way to secure figures on the average life of the plates.

A very rigorous standard has been adopted in determining the end of the life. No battery is allowed to remain in service after it falls below its rated capacity, as given above. This is made possible by reason of a most valuable characteristic of cells of the Exide type, i, e., the maintenance of a very constant capacity during most of the life of the plates. In other words, the capacity upon which the above figures are based is not the maximum reached by the cells in the course of their life, nor the average capacity during that life, but is the minimum capacity. The initial capacity is about 6 per cent above this capacity, or 4¼ hours at 39 amperes. This increases during the first 20 to 25 discharges to a maximum of 25 per cent above the rated capacity, or 5 hours at 39 amperes. From this point it gradually falls until the rated capacity is reached. The end of the life is then at hand, the fall in capacity from this time on being very rapid. Rating the cells on this basis results in great satisfaction to the user, as the average capacity during the whole life is upward of 12 per cent in excess of the rating. The average maximum capacity has been given as 25 per cent higher than the rated capacity, or 5 hours at 39 amperes. This is a conservative figure, many batteries rising as high as 5¼ to 5½ hours at that rate, and few failing to go as high as 5 hours.

The high capacity attained by these batteries has made possible continuous runs on a single charge far in excess of the 42.7 miles given as the mileage capacity under average conditions. The New York Transportation Company appreciates that an abnormal performance under special conditions has little practical value, and no special effort has been made to establish a record. Runs of over 60 miles have, however, been made on several occasions, both in regular operation and under test conditions. The average capacity, as ascertained by recent test discharges, of the 7 batteries which had made, up to Feb. 1, over 4500 miles, is 4¼ hours at 39 amperes. All of these batteries are still in operation and doing as good work as at the beginning of their life. The average capacity of all the other batteries still in service (62 out of the original 75) was, on Feb. 1, about 4½ hours at 39 amperes. A conservative estimate of the average life which will be obtained would seem, therefore, to be not less than 4500 miles. This refers only to the positive plates. The negative plates in all of these batteries show much less deterioration than do the positives, many being apparently as good as when first placed in service. There is no doubt but that a majority of them will be able to outlast a second set of positives.

Assuming that only one-half will have a life double that of a set of positives (and this estimate is a safe one), the total life of one-half will then be 4500 miles, and of the other half 9000 miles, or an average life for all negative plates of 6750 miles. If, then, the life of the positives be 4500 miles, the average life of all plates will be 5625 miles. At the end of this life the plates are still worth from $30 to $40 as scrap lead.

These figures have been most carefully checked and are believed to under, rather than overstate the life of elements of this type. The life of the Chloride-Manchester elements is much greater than that of those of the Exide type, and has not been so accurately determined. As operated by the New York Transportation Company, these batteries suffer, in common with the Exide batteries, in being necessarily operated on a mileage per charge much below their capacity, the average being only 10 miles. As an average of but one charge per day is given, the yearly mileage of these batteries is in the neighborhood of 3600 miles. The oldest batteries of the Chloride-Manchester size now in use have been in service only two years and show but little deterioration except where there have been adverse conditions.

Prior to the introduction of the wood separator, and during the months just previous to the removal of the company to its present station at Forty-ninth Street and Eighth Avenue, operation was conducted under great difficulties. The old station, located at 1684 Broadway, had been outgrown, the business having assumed such proportions that the equipment and floor space were no longer adequate. During this time the batteries did not receive the attention necessary to satisfactory results, and for a time deterioration was rapid. Another reason why better data as to the life of batteries of the Chloride-Manchester type is not available is the fact that the earlier years were, to a great extent, years of experiment. The vehicles used during 1897, 1898 and 1899 were equipped with various sizes of battery, and it was not until 1900 that an equipment was secured using a uniform size in all vehicles of the brougham and hansom types. Many of the older vehicles were sold and others were reconstructed to adapt them to use the new size of battery. The older batteries, therefore, became obsolete before the end of their life had been reached. The company still has in its possession many of these old sets, and they are gradually being made use of by reconstruction and adaptation to the present equipment.

FIG. 5.—BATTERY-CHARGING SWITCHBOARDS.

Another use which is being made of these obsolete batteries is in connection with the express cars operated by the Metropolitan Express Company, one of the sub-companies owned by the Transportation Company. These cars are at present equipped with both ploughs and overhead trolley poles, adapting them for operation on either the underground or overhead systems at will. To still further increase the scope of operation, a number are to be equipped with storage battery auxiliaries, making it possible to run them on the tracks of the various horse-car lines as well. Cars thus equipped with bat-

teries formerly used on the vehicles have been successfully experimented with, and the work of preparing a number for this service is now under way.

But while data regarding the Chloride-Manchester type, of accuracy equal to that of the Exide type is not at hand, much is known about the life of individual batteries, and fair conclusions may be drawn from an examination of the older of those batteries now in service, which have already made from 5000 to 8000 miles. A calculation based on all available information gives as the life of Manchester positive plates 12,000 miles, and as that of the Chloride negatives 20,000 miles, or an average for both of 16,000 miles, or 140 per cent more than that of the Exide plates. This would appear to constitute a very material difference in the cost of operation of the two types, and, taken alone, it would do so. But—and this point is too frequently overlooked—there are other factors in the total operating cost. The labor in handling and charging, for instance, will be, per vehicle mile, twice as great in the case of the Chloride-Manchester battery, averaging ten miles per charge as for the Exide running 20 miles per charge; the labor to charge each being approximately the same. The Exide operated 20 miles per charge is also somewhat more efficient than the Chloride-Manchester running 10 miles per charge, as explained above. These considerations reduce the apparent difference in cost of operation and the greater mileage capacity of the Exide makes it, for some classes of service, far preferable.

While on the subject of the life of the Chloride-Manchester batteries, it may be stated that the capacity during the life is even more constant than that of the Exide elements. The initial capacity is about 8 per cent in excess of the rated capacity, rises very slowly to a maximum of 15 per cent to 17 per cent in excess, and, after falling gradually to the rated capacity, remains constant at that point for a long time. The introduction of wood separators has greatly improved the performance of these batteries by preventing "weak" or "dead" cells due to partial short-circuits, as explained, and the present average capacity of all the sets of this type now in use is about 6 per cent to 8 per cent above the rating.

Under "Renewals" come also the separators. The life of these has already been mentioned, and this expense is small. Cleaning, the next item in the cost of "Maintenance," is made necessary by the gradual accumulation of sediment in the bottom of the jars. The plates rest on ribs which are two inches high. The active material is thrown down more rapidly from the Exide than from the Manchester plates. Cells of the former type require cleaning after each 1500 to 1800 miles, and of the latter after each 2400 to 2800 miles. With the corrugated perforated hard rubber separators Chloride batteries had to be cleaned after only 600 to 1200 miles, due to the sediment lodging between the plates instead of falling to the bottom. If cleaning be delayed after the sediment accumulates in sufficient quantity to touch the bottom edges of the plates, deterioration is very rapid. A watch is therefore kept on the mileage, and examination made from time to time, and the cells cleaned out promptly when it becomes necessary. The work of cleaning is systematized and is not a serious matter. A set of clean jars in a tray is provided, the connecting straps are cut and the elements lifted out, rinsed off and placed in the clean jars. Fresh acid is then put in, the straps reburned, and the battery is again ready for service.

The third principal cost of "Maintenance" is that of repairs. While the mechanical battery handling equipment is admirably adapted to its work, occasional mishaps are unavoidable, and a portion of the repairs are of damage resulting from such accidents. The bulk of the repairs at present is of broken connecting straps. Many of the older batteries were equipped with straps which experience has shown are too weak. These are rapidly being replaced by heavier ones, and this source of trouble will soon be largely removed. Jar breakages average one per 1000 miles, most of this occurring in the battery room. As the majority can be repaired, this does not constitute a large item of expense.

Expenses of all kinds are kept down by requiring and maintaining a high standard of condition of the batteries. The regular routine includes frequent examination for all of the troubles which may develop, and these are at once corrected when found. Thanks to the careful design of the elements, there is absolute freedom from many of the ills to which a storage battery is popularly supposed to be, by nature, heir. Neither the Exide nor Manchester plates, as operated by the New York Transportation Company, buckle or grow even under severe ill-treatment, and they are sufficiently stiff and strong to withstand without injury the handling incidental to cleaning, repairing and reconstructing. Storage batteries do not demand the attention of skilled mechanics, but they do need reasonably intelligent care, and the cost of maintaining them will be a minimum if this be given regularly, and a maximum if given spasmodically. The New York Transportation Company has not found it necessary to provide a large force of skilled workmen to operate and maintain its batteries, a relatively small number of careful men, of ordinary ability, working under competent supervision, being able to handle all of the work.

The practical results of the system of caring for batteries is shown by an examination of what is known as the "Daily Trouble Report." This comprises a carefully kept record of every trouble necessitating the repair of vehicles in the streets or their being towed to the station through inability to run on their own power. The vehicles and batteries participating in these failures are carefully inspected and the results of the inspections incorporated in this report.

During the months of operation prior to and just following removal to the new station, and when, as stated, the batteries were, through stress of circumstances, improperly cared for, the cases of "power exhaustion" averaged from 5 to 7 per 1000 vehicle miles. In the new station, with the better care made possible by increased facilities, the number of cases of power exhaustion has been reduced to an average, during the last nine months of operation, of only 1.31 per 1000 vehicle miles. These figures include power exhaustion from all causes, and the great majority are due to improperly oiled bearings, defective motors, snow or mud covered streets, carelessness on the part of drivers in wasting power, attempts to make abnormally long runs, etc., etc. These figures are being improved upon, but already the showing speaks well for the batteries and for the system of charging and caring for them.

The good results secured are also undoubtedly due in a great measure to the improvements made in the vehicles and to the efficient administration which prevails in the department responsible for their condition. The power consumption has been reduced to the figures given by the change from pneumatic to solid tires, changes in the bearings, and a careful treatment of many other details, of which it is not possible, within the limits of this article, to speak at length. The storage battery is the least variable of the many factors involved in electric vehicle operation; yet it is, by the thoughtless, the one most frequently blamed in the event of failure.

The business of the New York Transportation Company has increased greatly within the year, and is limited only by the capacity of the equipment. Disregarding pleasure vehicles, suitable only for summer use, over 90 per cent of the vehicles owned are in constant operation, less than 10 per cent being the proportion out of commission from day to day for repairs of all kinds. To sum up this presentation of the situation, the New York Transportation Company is demonstrating, in its daily business, that the electric automobile has been developed to the point where, in reliability, radius of action and operating costs, it meets all the requirements necessary to commercial success, and that the development of a storage battery especially adapted to work under the rigorous conditions imposed, has contributed greatly to this result.

So far from being an insuperable obstacle to the success of electrically propelled vehicles, the battery is to-day better adapted to its work than some other portions of the equipment, and, in point of maintenance cost, a smaller factor in the total expense of operation than are, for instance, the rubber tires on the vehicle it runs.

A Big Cable Ship.

The submarine-telegraph cable ship *Colonia*, built to the order of the Telegraph Construction & Maintenance Company, Limited, was launched last month, and will when finished proceed to the Pacific to lay the cable that will connect the mid-Pacific possessions, Fanning Island, with Vancouver. This done, the cable will be continued to New Zealand, and thence to other British possessions. The dimensions of the *Colonia* are: Length, 500 feet; breadth, 56 feet; depth, 39 feet. The vessel will be capable of carrying 10,000 tons dead weight, and is expected to develop a speed of about 11½ knots. She has an overhanging bow, and an elliptical stern, both of which are fitted with the necessary cable gear. Built up in her holds are four tanks, in which can be carried no less than 3000 nautical miles of cable. As the *Colonia* is destined to work in all climates especial attention has been paid to ventilation. The machinery for propelling the ship and for laying submarine cables is of the latest improved type, while the arrangement of the quarters, both private and official, of officers and crew, the electricians, engineers, etc., are on a fine scale.

The American Electrochemical Society.

THE first meeting of the American Electrochemical Society, which was held at Philadelphia April 3, 4 and 5, was successful from every point of view. Eighty-seven members were registered as in attendance, and at some of the meetings the audience numbered 100 or more. Twenty papers were read and the discussions which followed were excellent, both in form and matter. Indeed, in conciseness and in keeping to the point, some of the older technical organizations might well take a lesson from the inaugural proceedings of the new society, and it is to be hoped that the latter in future meetings will not depart from the standard thus set.

The society was officially inaugurated at a business meeting held Thursday evening in the Manufacturers' Club. The meeting was

Prof. J. W. Richards,
President Am'n Electrochemical Society.

preceded by a dinner at the club, and though not on the programme, in response to calls from the diners, Messrs. Hering, Reed, Richards, Keith and several others, enlivened the occasion with postprandial remarks. After the dinner a meeting was organized with Prof. J. W. Richards as chairman. Mr. Hering read the minutes of the temporary organization from which the Philadelphia meeting proceeded. For several years several engineers in Philadelphia had met twice a month to discuss electro-chemical subjects, and with these gentlemen the movement for the organization of the Electrochemical Society originated. Though the names of these gentlemen were not mentioned at the meeting, we may say that they were Messrs. Hering, Reed and Roeber. When a circular was sent out to those likely to be interested, suggesting the formation of the Society, the plan was to proceed with the organization of the Society if 75 favorable replies were received. The first mail brought in 40 favorable responses, and not many days later almost 300 accessions were received, which had reached 327 up to the date of the meeting, and rose to 363 at adjournment.

After the reading of the minutes the necessary formal motions for the organization of the Society were made and carried. There was some discussion as to the manner of writing the name of the Society—whether "electrochemical" should or should not be hyphenated; upon vote being taken, a majority favored writing the word unhyphenated. Mr. Hering, as chairman of the Committee on Constitution and By-laws, submitted a draft of a constitution, which was discussed article by article and finally adopted with a number of changes.

The article dealing with the officers of the Society was first disposed of and a committee then appointed to recommend nominations for the various offices as follows: President, secretary, treasurer, six vice-presidents and nine managers; the vice-presidents to hold office for two years and the managers for three years. Later the discussion on the constitution was interrupted to receive the report of the committee, which recommended the following names: President, Prof. J. W. Richards, of Bethlehem; secretary, C. J. Reed, of Philadelphia; treasurer, Dr. P. G. Salom, of Philadelphia; vice-presidents, Prof. H. S. Carhart, of Ann Arbor; Prof. W. D. Bancroft, of Ithaca, N. Y.; Prof. C. A. Doremus, of New York; Prof. L. Kahlenberg, of Madison, Wis.; Prof. W. R. Whitney, of Boston, Mass., and Mr. C. M. Hall, of Niagara Falls. Managers, Prof. S. P. Sadtler, of Philadelphia; Dr. E. F. Roeber, of Philadelphia; C. O. Mailloux, of New York; W. D. Weaver, of New York; Dr. Samuel Sheldon, of Brooklyn, N. Y.; Carl Hering, of Philadelphia; Edward Weston, of Waverly Park, N. J.; E. G. Acheson, of Niagara Falls, and Col. Samuel Reber, U. S. A., of Washington, D. C. The ticket as presented was unanimously adopted by the meeting. Owing to the length of the discussion of the constitution, the meeting did not adjourn until a late hour.

On Thursday afternoon, preceding the formal organization of the Society, a visit was made to the chemical works of Harrison Brothers & Company in order to see in operation the Darling process for the electrolytic production of sodium and nitric acid from nitrate of soda. The electrolytic cells consist of an iron pot within which and extending close to the bottom, is a pair of concentric cylinders of perforated iron, the annular space between the two being packed with powdered magnesia. The outer vessel forms the anode, and the carbon electrode is submerged in the fused electrolyte contained within the inner concentric cylinder. In order to prevent these cylinders from being attacked, they are in shunt connection with the anode. The drop of voltage in each cell is 15 volts. A pipe leading from a space between the cylinders and the outer vessel carries off the gases liberated, which elsewhere are condensed and form nitric acid. The sodium floats on top of the space enclosed by the inner cylinder and at intervals is ladled out and deposited in tin cans; paraffin is first placed in the bottom of these cans, and as the sodium is added this material floats on top and protects the surface from the atmosphere. No difficulty has been found in handling the sodium, though, of course, every precaution is taken to obviate the presence of moisture.

In the same works there is apparatus for the electrolytic production of cyanide, but the details of the process were not divulged to the visitors. The same company is completing a new type of primary battery, which is soon to be placed upon the market. The negative element consists of a lead plate which has been pasted with red lead and "formed" to peroxide. An alkali electrolyte is used. The positive element is a hollow zinc rod open at one end; the wire connection passes through a lateral hole near the bottom of the rod, and the interior is filled with mercury, the creeping of which over the top keeps the rod amalgamated. It is claimed that this battery is superior commercially to other constant-current types now in use.

At a meeting of the Council during the sessions, it was decided to hold the next meeting of the Society at Niagara Falls next September.

C. J. Reed, Secretary
Am'n Electrochemical Society.

While no regular programme of meetings has yet been fixed upon, it is probable that the regular annual meeting will in the future be held in connection with the annual convention of the American Institute of Electrical Engineers.

As stated above, twenty papers were presented, abstracts of which and the following discussions are given below. The papers were not printed in advance, but hereafter printed copies of papers to be read will be distributed prior to reading. The proceedings of the meeting will soon be issued and sent to the membership, and will probably form a volume equivalent to about 200 pages of the A. I. E. E. *Transactions.*

A UNIVERSITY COURSE IN ELECTROCHEMISTRY.

The first paper on the programme was read by Prof. J. W. Richards, the title being as above. In opening, Prof. Richards said that there have scarcely been special courses in electrochemistry in American universities in the past. That branch in some of its various aspects formed part of a course in chemistry or in metallurgy, or in electrical engineering. According to Prof. Richards, the course in electrical engineering is not to be recommended, because it gives no adequate training in chemistry. To take first a course in chemistry or metallurgy, and to take up electrical engineering afterwards, was a very good policy, but required at least six years. The author then gave an outline of what he considers to be the best course for a four years' study of a student who has graduated from a good high school. In its general lines, it is a course in metallurgy, but modified by leaving out some branches, like geology, hydraulics, etc., and replacing them by suitable sections of electrical engineering, such as electrical instruments, generators, laws of electrolysis and electric furnace work. He urges that the student should become familiar with the methods of calculus, and should receive an insight into the principles of theoretical chemistry. He recommends reading of technical literature in foreign languages. At the end of his paper he gave an outline of the subjects to be taken up in the different years.

The discussion brought out what is being done in electrochemistry in some American universities, the courses resembling more or less that outlined by Prof. Richards. The discussion was participated in by Prof. Bancroft, of Cornell; Prof. Carhart, of the University of Michigan; Prof. Burgess, of the University of Wisconsin, and Prof. Doremus, of the College of the City of New York. Prof. Burgess made a distinction between an electrochemical engineer and an electro-chemist, the former being primarily an engineer, the latter primarily a chemist. Prof. Bancroft agreed with him in this distinction. Prof. Doremus urged that organic chemistry should not be neglected, as there are very promising possibilities in the application of electrical methods in organic chemistry.

ELECTRODES.

The next paper, read by Mr. Clarence L. Collins, engineer of the Acheson Company, of Niagara Falls, was on the subject of electrodes. The paper was limited to the discussion of the use of artificial graphite electrodes in furnace work. Different forms of carbon have different temperatures of oxidation, and that of graphite is higher than of amorphous carbon by several hundred degrees. When reduction of an oxide takes place in the presence of two forms of carbon of different temperatures of oxidation, the one with the lower temperature of oxidation is consumed in preference to the other. One can, therefore, make the electrodes of graphite, while in the mixture to be reduced, an easily consumed form of carbon may be used, like charcoal. Another characteristic feature which distinguishes graphite from other forms of carbon is that graphite can easily be cut by machines. This makes it possible to cut easily artificial graphite electrodes of any form wanted for the practice. The author showed diagrams of different forms of electrodes for furnace work, some involving considerable machine work, and discussed the best and cheapest construction of the electrodes for large furnaces and for large currents. He gave some very interesting results of comparative tests with amorphous carbon electrodes and of graphite electrodes in practical furnace work in industrial processes on a large scale. These results, as stated, show the much greater resistivity to oxidation of the graphite electrodes; their efficiency was found four to eight times as great as that of amorphous carbon, while their price is only three times that of the latter.

In the discussion which followed, several speakers spoke of the use of graphite electrodes in the electrolysis of solutions. Graphite anodes were very highly recommended for the electrolysis of chlorides, for which purpose they are practically indestructible. Graphite anodes, used in the electrolysis of sulphates, are destroyed by oxidation; they are therefore not recommended for this purpose. Mr. Collins also described how the creeping of solutions upwards in the porous electrodes, with resulting corrosion of the joints, can easily be avoided by destroying the porosity by means of paraffin, the graphite electrodes being partly suspendid in a kettle of melted paraffin, so that the pores may be filled with paraffin.

A NOTE ON THE GLADSTONE-TRIBE COUPLE.

The following paper with the above title was read by Dr. Wilder D. Bancroft, of Cornell University. The Gladstone-Tribe couple is prepared in the most effective way by dipping zinc foil into a copper sulphate solution, rinsing, drying, and then heating the mixed zinc and copper to a temperature nearly that at which brass would be formed. This couple can be used for certain reductions, for instance, of chlorates to chlorides. It is certain that the action is electrolytic in principle, but a detailed investigation of this action was before impossible, because one could not reproduce the phenomena by the use of a voltaic cell. The author has now succeeded in doing so, having reproduced some of the phenomena with a pair of zinc plates or a pair of copper plates, and an external e. m. f. For instance, with copper electrodes he has reduced potassium chlorate to chloride and has varied the conditions of the experiment, in order to determine the influence of current density, temperature, concentration, etc. When determining the ampere-hour efficiency under assumptions as they would be ordinarily made, he found an efficiency of 180 per cent. Therefore the assumptions cannot be correct, and the author explained the cause of the error. He points out that while his investigation is not yet complete, his preliminary results show the possibility of performing electrolytic reductions with a much better efficiency than has in general been obtained by purely chemical methods.

THE NASCENT STATE.

In a paper with the above title, Mr. C. J. Reed attacked the nascent state theory. This hypothesis of the nascent state has, he said, been made to hide the ignorance of phenomena incorrectly understood, and has fulfilled this purpose for nearly a century. It is now time, however, to lay it aside, as it is no longer required for assistance in the explanation of experimental facts. The substance most frequently called upon to exercise the functions of a nascent body is hydrogen. The assumption of a peculiar reducing power, supposed to appertain to nascent hydrogen, has been made through mistaking coincidence for cause. The fact that hydrogen and other bodies are frequently reduced in juxtaposition by the same reducing agent, is the only ground for supposing that the reducing agent first causes the liberation of hydrogen and that the hydrogen in turn reduces the other substance. All hydrogen in being liberated from whatever source necessarily passes through the nascent state, and therefore we have as many ways for producing nascent hydrogen, as there are of liberating hydrogen. This enables us by the selection of a proper method to examine the effect of nascent hydrogen alone on a body and so determine whether it possesses reducing power different from hydrogen in its ordinary state.

As an illustration, a lead salt may be reduced to metallic lead in contact with nascent hydrogen, or it may not be reduced in contact with nascent hydrogen, depending on the nature of the reducing agent which evolves the hydrogen. It must be admitted, however, that if nascent hydrogen from one source reduces a metal, nascent hydrogen ought always to reduce the same metal. If metallic zinc in contact with metallic copper be immersed in hydrochloric acid, nascent hydrogen will be formed abundantly at the surface of the copper plate. If a lead salt be introduced in contact with the copper, metallic lead will be precipitated on the copper along with the hydrogen. If, instead of metallic zinc, metallic tin is used in contact with the copper, nascent hydrogen is formed in a similar manner, but this combination is unable to reduce lead. Hence it must be concluded that the reduction of the lead must be caused not by the nascent hydrogen, but by the reducing agent which simultaneously forms the nascent hydrogen.

Among the substances having greater chemical energy than hydrogen, which have been supposed at divers times by various philosophers to have been reduced by nascent hydrogen, are the alkaline and the alkaline earth metals, and also magnesium, aluminum, manganese, iron, zinc, cadmium, lead, and tin; but it may be shown in a manner similar to that described before that the nascent hydrogen may be formed in contact with any compound of any of these metals without the slightest reduction.

Another general class of reductions which have been assigned to the activity of nascent hydrogen is that of substances which have less chemical energy than hydrogen. Among these substances are gold, silver, copper, mercury, arsenic, antimony, and also various acids and powerful oxidizing reagents, such as iodic and nitric acids. That the nascent hydrogen, with its peculiar reducing power, is not necessary to the reduction of these substances, is proved by the fact that they may all be easily reduced by electrochemical action with a source of current having a lower e. m. f. than that required to form nascent hydrogen. Iodic acid has been frequently cited by chemists as an illustration of the great reducing power of nascent hydrogen, simply because in the electrolysis of iodic acid iodine appears at the cathode,

notwithstanding the fact that the e. m. f. required in this case is less than that which under these circumstances can possibly form nascent hydrogen. If it be assumed that the energy required for the liberation of nascent hydrogen is simultaneously restored to the circuit by the recombination of the hydrogen, such an assumption would amount to the admission that nascent hydrogen has no power of reduction, but merely transmits the energy or electric charge to another body, which it has received from the electric current. This is equivalent to the admission that the hydrogen merely acts as an electric conductor and that its action is in no wise different at a cathode from its action in any other part of the electrolyte, or from the action of any other positive ion in any part of the electrolyte.

The paper led to a long discussion, in which, among others, Profs. Doremus, Bancroft and Richards participated. It was pointed out that for the explanation of certain chemical actions it is difficult to give up the assumption of a nascent state. The subject of catalysis was also touched upon. Mr. Reed, in his reply, contended that the arguments brought forward against him did not refute his views.

THE ELECTROLYTIC REDUCTION OF LEAD.

Mr. Pedro G. Salom, of Philadelphia, read a paper describing a process of his invention for electrolytic lead reduction which is in operation at Niagara Falls. The principle lies in the use of lead sulphide as cathode in an acid solution, the hydrogen cation forming with the sulphur gaseous hydrogen sulphide, and thus reducing the lead sulphide to lead in spongy form. The form and construction of the cells used were described and the difficulties discussed which had been encountered. The principal difficulty was that the reduction was not complete, and the degree to which the ores are reduced varies without apparent reasons. It was stated that at present 92 to 95 per cent of the sulphide is reduced. Another difficulty is that the workmen's eyes are affected in the operation of the process. Two pounds of lead are produced per horse power-hour, 48 cells in series being electrolyzed at 130 volts. Specimens were shown of spongy lead, compressed sponge, litharge and other materials made by Mr. Salom's company. Owing to the spongy form, the material is very readily transformed into litharge. The company intends to take up later the manufacture of storage battery plates.

THE ELECTROLYTIC REFINING OF COMPOSITE METALS.

The final paper of the morning session was read on the above subject by Mr. Titus Ulke, superintendent of the copper refining department of the Lake Superior Power Company, Sault Ste. Marie, Ontario. The author first gave a review of the different methods patented by various metallurgists for the electrolytic treatment of composite ores, and then described in detail his new process, which is claimed to be especially suitable for extracting copper and nickel of commercial purity from nickeliferous copper material. It is best to use a material that contains not more than 20 per cent of nickel and not less than 80 per cent of copper. He casts this material into plates and uses them as anodes in a solution of sulphate of copper and nickel, sheets of copper being used as cathodes. The anodes are gradually dissolved by the current and commercially pure copper is deposited on the cathodes, while the electrolyte tends to become poorer in copper and richer in nickel. A certain amount of the electrolyte is regularly withdrawn containing just as much nickel as has been dissolved from the anode subsequent to the last withdrawal. The amount of electrolyte thus withdrawn is replaced by enough acid solution of copper sulphate to reproduce the original condition of the electrolyte.

The next step in the process is to separate the two metallic constituents of the withdrawn acid electrolyte, which may be done by any suitable method, and two such methods were described by the author. From the nickel salt obtained an ammoniacal solution is made, from which the nickel is deposited by electrolysis, an insoluble anode being used. Good results have been obtained with a lead anode which remained practically intact, barely a trace of lead being deposited with the nickel. As during this last step of electrolysis the electrolyte tends to become impoverished in nickel, portions are periodically withdrawn and the contained nickel salt and the ammonium sulphate or ammonia are recovered, the latter being used to make the nickel-depositing electrolyte ammoniacal. Nickel sulphate obtained from both the solutions withdrawn from the copper-depositing system and the nickel-depositing system is added to the nickel electrolyte to keep up its normal strength. From tests made, Mr. Ulke believes that his process, when worked on a commercial scale, will give nickel of great purity and at a comparatively small cost.

After the conclusion of Mr. Ulke's paper, lunch was taken at Houston Hall, the University of Pennsylvania having extended a cordial invitation to the Society. The afternoon session was held at the Randal Morgan Laboratory of Physics, and began at 2 o'clock.

A NOVEL CONCENTRATION CELL.

The first paper of the afternoon meeting was read by Prof. H. S. Carhart, of the University of Michigan, and described an extremely interesting cell having several very remarkable properties. The author opened with a brief discussion of the well-known relation between the e. m. f. of a cell, the heat tonings of the chemical processes in the cell, and the temperature coefficient of the e. m. f. (generally called Helmholtz's modification of Thomson's rule). He then briefly discussed Nernst's theory of concentration cells and pointed out that all concentration cells previously investigated, have an e. m. f. of such a direction that the current in the cell flows from the dilute solution to the concentrated solution. This is, for instance, the case in a concentration cell, consisting of two zinc electrodes in two solutions of sulphate of zinc of different concentrations. This rule regarding the direction of the e. m. f. of a concentration cell has been regarded to hold good for all concentration cells, but the author has found a combination to which it does not apply.

The cell consists of two nickel electrodes in two solutions of nickel sulphate of different concentrations. The e. m. f. has here such a direction that the current in the cell flows from the concentrated solution to the dilute solution. Not only is this direction of the e. m. f. of the cell extraordinary, but the magnitude of the e. m. f. has a much higher value than concentration cells otherwise have under corresponding conditions. The author accounted for the peculiar behavior of this cell, which he had anticipated from theoretical reasons. It is due to thermo-electric effects, the temperature coefficient being enormously large. He said that he is not an opponent of the ionic theory, but the facts ascertained experimentally concerning the behavior of this cell seem to be in disagreement with Nernst's theory of concentration cells; and although this theory has proven to agree with the facts in all cases heretofore investigated, one single exception would prove fatal. The author believes that the ionic theory of concentration cells has been built up on assumptions which are not yet fully worked out; but he would not deny that possibly the ionic theory might find a way to account for the thermo-electric effects, which are of importance in this case.

The paper was discussed at length. Mr. Reed remarked that in building up a large number of various concentration cells, he found that a nickel cell behaved in a way different from other cells; but he did not push his experiments on this point further. Dr. Roeber pointed out that when in the nickel concentration cell the electric current flows from the concentrated to the dilute solution in the cell, the concentrated solution must become still more concentrated and the dilute solution still more dilute, which is remarkable. Mr. Hering showed that the behavior of the cell is peculiar when considered from the point of view of the conservation of energy. Dr. Bancroft referred to experiments which he has made with amalgam cells, and pointed out that frequently the erroneous supposition is made that the heat of dilution is zero. Sometimes the Helmholtz formula is applied with this term lacking, thus giving rise to erroneous results. With all terms included, some so-called contradictions will be found not to exist.

Mr. Reed then showed a number of gravity concentration cells, all made up in the following way: In a test tube two solutions are placed one above another, that of lower specific gravity being at the top--for instance, silver nitrate and lead nitrate. If a silver rod is placed in the test tube, this arrangement acts as a short-circuited cell, silver being dissolved where it is in contact with the lead nitrate and deposited where it is in contact with the silver nitrate. This is a special case of concentration cell, the lead nitrate behaving like a silver nitrate solution of zero concentration of the silver ions. Mr. Reed showed a number of other concentration cells of the same type, the silver being replaced in them by other metals.

THE MANUFACTURE OF BISULPHIDE OF CARBON IN THE ELECTRIC FURNACE.

In a paper with the above title, Mr. Edward R. Taylor described his process of manufacture of bisulphide of carbon. The first electric furnace built was surrounded with an external sheet of iron in which the sulphur was melted by heat radiated from the inner metal shell of the furnace, and admitted to the furnace proper by means of valves. This practice was found to be inconvenient, and has been superseded

by a new arrangement in which brick walls are substituted for those of metal, and the sulphur fed directly to the furnace in the cold state, surrounding the interior so completely as to make a blanket of sulphur which in melting carries the heat absorbed back to the furnace. There is practically no limit to the size of such furnaces. A furnace, of which diagrams and photographs were shown, is 16 feet in diameter and 41 feet in height. The operation of the furnace was stated to be extremely satisfactory. Profs. Richards and Doremus spoke in high terms of the merits of Mr. Taylor's invention.

CURRENT ELECTROCHEMICAL THEORIES.

In the absence of the author, Dr. Louis Kahlenberg, of the University of Wisconsin, his paper with the above title was read by Prof. Burgess. The author gave a review of the development of electrochemical theories in the last century. He discussed at length the dissociation theory and said that true credit is due to this theory for having elicited a large amount of experimental research, but he thinks that had the facts, as known at present, been known in 1888, it is safe to say that the theory of electrolytic dissociation would not have been born. It has been unfortunate that so much researches have been made with dilute solutions, as they represent only a special case, and he thinks, a very complicated one. Compared with Helmholtz's monumental work on the thermodynamics of galvanic cells, Nernst's osmotic theory appears like an artificial reproduction.

In the discussion which followed, Prof. Carhart called attention to the fact that the modification of Thomson's rule, taking into account the temperature coefficient of the e. m. f., is due to Willard Gibbs. Prof. Bancroft remarked that while this is true in a general way, the exact quantitative formula was first given by Helmholtz.

A ZINC-BROMIDE STORAGE BATTERY.

Mr. Herbert H. Dow, of Midland, Mich., described a cell made of Zn and C as electrodes and $Zn\ Br_2$ as electrolyte. When a current is passed, flowing in the cell from the carbon to zinc, zinc is deposited and $Br_2\ C$ is formed. The e. m. f. is 1.7 volt. It is quite remarkable that when short-circuited and opened again, the e. m. f. of the cell comes instantly back to 1.7 volt. The cell may therefore be used as a standard cell for commercial purposes.

CONTINUOUS ELECTROLYSIS OF SOLUTIONS OF METALS.

The next paper was read by Dr. N. S. Keith, of New York, and dealt mainly with the electrolytic treatment of sulphides of copper and iron. The first part of the paper dealt with the reactions which take place during the process discussed by him, while in the second part he discussed the methods by which continuous operation is carried on without waste. The mechanical arrangement of the electrolytic vats, the numbers of the electrodes in the different vats, the regulation of the current density, etc., were described.

A METHOD OF ELECTROLYTIC PRODUCTION OF ZINC FROM ITS ORES.

Mr. Samuel S. Sadtler, of Philadelphia, presented a paper treating of a means of dissolving certain metals, notably zinc, tin, silver and gold, in alkaline solution by means of alkaline hypochlorites. The process is said to be cyclic, involving the treatment of the metals, scraps or ores with the solutions, electrolyzing them so as to obtain the metals and at the same time regenerate the solutions used for acting upon fresh quantities of metals. The author claims, by means of suitable solutions for the several purposes, to make a number of separations, such as zinc from lead, iron and manganese; copper from iron, and gold and silver from lead.

THE ELECTROLYTIC RECTIFIER.

The next paper was a joint paper by Prof. C. F. Burgess, of the University of Wisconsin, and Carl Hambuechen, on the electrolytic rectifier. The peculiar behavior of the aluminum electrode, which makes it suitable for an electrolytic rectifier, is assumed to be due to the formation of an insulating coating of oxide. This coating is, however, not entirely insulating, but has a certain large resistance. A small leakage current is thus enabled to flow, which passes through small points and parts of the electrode irregularly distributed over the plate. Pictures were shown of the condition of the aluminum plate at different stages. The losses in the cell were then discussed in detail, and curves were shown for the e. m. f., current, and losses, from tests made with an aluminum and a lead electrode, potassium phosphate being used as electrolyte. The efficiency obtained in this case was only 30 to 40 per cent.; much higher efficiency claims have been made by others for the same arrangement. Curves were given, showing that the amount of leakage with continuous pressure applied is very small; that it is much larger with alternating pressure applied; and further, that the plate broke down (due to excessive sparking) at a much lower voltage with alternating pressure than with direct pressure. It is therefore wrong to make experiments with continuous pressure and draw therefrom conclusions concerning the behavior at alternating pressure.

The authors have found that a fused electrolyte is much more promising for commercial application than an aqueous solution. They used fued sodium nitrate and obtained finally an efficiency of over 80 per cent. They made continuous runs for a long while, in order to determine the cost for commercial purposes. The cost of rectifying was found to be ¼ cent per kilowatt-hour. The rectified current is pulsating. Such pulsating current has been formerly claimed to have advantages over steady direct-current for the purpose of charging storage batteries, but tests made on this point did not show anything of that kind, the efficiency and capacity being found the same with both kinds of current. The latter result was contradicted in the discussion by Mr. Sperry, who had found that pulsating current is better for charging storage batteries than direct current, the increase of efficiency being 9 per cent.

CAUSTIC ALKALIES AND CHLORINE BY THE DRY ELECTROLYTIC PROCESS.

The next paper was by Mr. Charles E. Acker, of Niagara Falls, and described his electrolytic process for the production of chlorine and caustic alkali. The principle of the Acker process is well known from numerous patent specifications, and was the subject of an article by C. T. Townsend, printed in our issue of last week. The inventor spoke about the numerous difficulties which had been regarded as insurmountable by some critics, but which were successfully overcome. He described the original experimental plant in Jersey City, and referred to experiments made with a view to manufacturing storage battery plates. He then described the present plant in Niagara Falls where his process is in operation at an industrial scale. 8000-ampere furnaces are used. There are four anodes, hence 2000 amperes for each, the current density being 2750 amperes per square foot. There is no wear and tear of the anodes. The only weak point relates to the connections between the anodes and the copper, the joints being gradually eaten off, but these connections have lately been considerably improved. The efficiency of the process is given as 100 per cent, this being the nearest integer number. Since 1900 the works have been in continuous operation. There have only been a few interruptions, one due to a fire in the Niagara generating plant, and another to stones falling upon the roof of the generating house. In his new form of furnace there is nothing liable to corrosion. The low current density formerly used was the main trouble, causing low efficiency. This has now been successfully overcome.

THE RELATIVE SPEED OF THE IONS IN SOLUTIONS OF SILVER NITRATE IN PYRIDINE AND ACETO-NITRITE.

The last paper of this session was by Dr. Herman Schlundt, of Madison, Wis., on the above subject, and in the absence of the author was read by Dr. Bancroft. The author points out that in these solvents the changes of the relative velocities of the ions with the concentration are quite different from those in aqueous solutions. This might be explained as being possibly due to complex ions. There would then be complex positive ions in aqueous solutions and complex negative ions in pyridine solutions. The enormous influence of the solvent is evident.

The afternoon session was closed at 6 o'clock. There were, therefore, on this day two sessions, each of four hours. That the audience of over 100 members and friends remained through these eight hours until the close of the session and followed the reading of the papers and the very animated discussions speaks well for the quality of the papers, and not less for the quality of the audience.

The Saturday session was held again in the John Harrison Laboratory of Chemistry and called to order at 9 o'clock by President Richards.

A NEW TYPE OF ELECTROLYTIC METER.

The first paper of the day was a description by Dr. Konrad Norden, of New York, of a new type of electrolytic meter. In the absence of the author, the paper was read by Mr. Carl Hering. The meter measures not only ampere-hours, but is also a maximum meter, registering the ampere-hours during which the current rate is above a certain limit, and also those during which it is between given limits. The meter consists in principle of a cell with polarizable electrodes, requiring a well defined minimum e. m. f. for decomposition. When the electrolyte is decomposed, this indicates a voltage beyond the

critical minimum point. A maximum current can be indicated by the cell if it is shunted by a resistance calculated, so that at the maximum current rate the drop of voltage between its ends becomes equal to the decomposition voltage of the cell. The ampere-hours above a fixed ampere rate are determined by measuring the amounts of products of decomposition, for instance, the volumes of the developed gases. The meter may consist of two electrodes of spongy platinum in acidulated water, the e. m. f. of decomposition being given by the author as 1 volt. If the resistance in shunt with this cell is 1-300 ohm, any current above 300 amperes produces decomposition. In parellel with this cell, another cell may be used with another decomposition e. m. f., say, 1.33 volt; this second meter registers a current above 400 amperes. The difference between the indications of the two meters gives the ampere hours at current rates between 300 and 400 amperes. In the discussion Mr. Reed expressed his doubts concerning the practicability of the apparatus.

THE REVERSIBLE COPPER OXIDE PLATE.

The next paper was read by Mr. Woolsey McA. Johnson, of Hartford, Conn., on a reversible copper oxide plate. The author described the method of making copper oxide plates and gave interesting curves of the e. m. f. of a copper oxide plate with a hydrogen electrode, which is a platinized platinum electrode saturated with hydrogen. When in these discharge curves the abscissas represent the time and the ordinates the e. m. f., such a curve may be described in a general way as follows: At first it is nearly a straight line parallel to the axis of abscissas; at a certain point it drops suddenly (represented nearly by a straight line parallel to the axis of ordinates); then follows another straight line parallel to the axis of abscissas, and so on. The several straight lines parallel to the axis of abscissas represent the e. m. f. of different oxides of copper with a hydrogen electrode. In the same manner charge curves were represented. Of practical importance was the conclusion of the author that, for several reasons, the copper oxide plate is not suitable as an accumulator plate.

A THERMODYNAMICAL NOTE ON THE THEORY OF THE EDISON ACCUMULATOR.

The next paper was read by Dr. E. F. Roeber, of Philadelphia, with the Edison storage battery, as a subject. The author discussed mainly the question as to the influences to which the voltage drop of a storage battery of the oxygen-lift type is due. It may be due to increase of internal resistance (which influences only the voltage at the terminals, not the e. m. f. proper), or also to a change of e. m. f. proper. The latter can be due either to a change of the battery plates from one state of oxidation to another, or to local concentration changes in the pores of the two plates. The effect of the latter can be exactly calculated by a thermo-dynamical method analogous to that used by Helmholtz for calomel cells and by Dolezalek for the lead accumulator. The result for a cell of the oxygen-lift type is that when the concentration of *K O H* in the pores of one plate increases to about 40 per cent, and that in the pores of the other plate decreases to about 10 per cent, the drop of the e. m. f. due to these concentration changes is several hundredths of a volt. This is not sufficient to account for the whole voltage drop, so that the other influences mentioned before must be of more importance.

In the discussion Mr. Reed doubted whether the operations, used in the thermo-dynamical cycles, could be performed in practice. Mr. Hering asked whether thermo-electric effects could not change the results of the calculation. Mr. Johnson considered that the voltage drop in the Edison battery is mainly due to increase of resistance; he also stated that he had found that the e. m. f. of a cell of the oxygen-lift type is practically independent of the concentration of the electrolyte used. Dr. Roeber replied that the latter case is different from that considered by him, and that the formulas and numerical results in both cases are different. Concerning the influence of thermo-electric effects, he said that in his method of calculation the temperature coefficient does not enter, because he calculates the change of what Helmholtz calls the "free energy" of a system, by an isothermic process.

ELECTROLYSIS OF AN AQUEOUS SOLUTION BY AN ALTERNATING CURRENT.

The next paper was read by Prof. J. W. Richards, of Lehigh University; on alternating-current electrolysis. While it is generally thought that electrolysis is only possible with direct current, the author showed that it may also be accomplished with alternating current, namely, in all cases in which the ions set free at the electrodes combine either with the electrode or with the electrolyte to form a precipitate. He gave the formulas for several special cases in which this takes place. He doubted, however, whether the method can be made useful in practice, as the output which he obtained in his experiments, too small. The output depends much upon the frequency of the alternating current used.

THE ATOM OF ELECTROCHEMISTRY.

The last paper of the meeting was read by Mr. Arvid Reuterdahl, of Providence, R. I., on the atom of electro-chemistry. This paper was an elaborate one, of a highly theoretical nature, and it is difficult in a brief abstract to do justice to the many fine points brought out. The author gave a critical review of the historical development of the various atomic theories of matter. He then discussed the implications of the kinetic theory of gases, and analyzed the fnndamental hypotheses of this theory and proved that they cannot withstand critical examination. He considered how the highest authorities have spent much work and ingenuity to get around weak points, but that such attempts are often at the best scarcely more than interesting exercises in pure mathematics. Regarding the four-dimensional space he made the sarcastic suggestion that within that space some eminent mathematician ought to be able to detect not only an ideal perfect atom, but also a storehouse for unlimited amounts of energy. He then took up at considerable length the problem of action at a distance. At the conclusion of his paper he pointed out that ionic conditions must exist in the realm of electrostatics and electrodynamics as well as of electro-chemistry, and that the manifold phenomenon of electricity will be found to be ultimately the result of the activities of the atom of electrochemistry.

With a strong recommendation in favor of the adoption of the metric system, the first general meeting of the American Electrochemical Society then closed.

An Interesting Sensitive-Flame Experiment.

By L. De Forest.

WHILE conducting experiments with Hertzian waves at the Armour Institute, Chicago, some time since, a rather new and striking sensitive-flame effect was accidentally brought to my notice. At the time I was carrying on the work at night, by the light of a Wellsbach gas-burner. An ordinary induction coil was used, giving at the time a 1-16-inch spark, and located twenty feet from the gas-burner.

The operation of this coil was frequently accompanied by a decided increase in the light in the room; and by altering the adjustment of the air-intake of the Welsbach burner, this increase of light produced by the spark could amount to several candle-power.

For this condition of maximum sensitiveness the mantel was put at considerably less than its maximum brilliancy, portions of it being at but red heat. The flame within, as in the case of the ordinary sensitive-flame, appeared to fan outwardly, at the sound of the spark, extend downward, and play upon the red portions of the mantel, causing these to incandesce. Hence the increase of light. There was a slight lag in the return to normal brilliancy after cessation of the sound.

When the coil was closeted, or placed behind a projecting wall, the effect on the light was naturally diminished; and when the door of the closet was almost but not quite closed, the effect was completely cut off, although the source was in plain view from the lamp.

At first sight this decided light effect from a coil spark might be readily mistaken for a new response to electric oscillations; but as a simple acoustic phenomenon the Welsbach mantel properly illuminated seems to afford an unusually sensitive sound-responsive device. The relative effect of different qualities of sound is very marked; it being, as is the case with the ordinary sensitive-flame for such weak sounds, practically unresponsive to ordinary sound or musical notes, but influenced chiefmost by the sharp crack peculiar to the electric spark. That from a small electric bell held not too far away also showed its effect.

As with the ordinary flame this is a pressure phenomenon. The relative proportions of gas and air have all to do with it. An excess of gas is necessary for the effect described, but by increasing the amount of air the reverse effect may be obtained, a diminution of the light by the sound. Between these two effects is a point of neutral regulation, near that of maximum illumination, at which the flame appears entirely deaf to any such sound. I have been able to obtain a falling off in the light of the mantel to one-half or one-third its normal brilliancy (which latter required to be made very low for this extreme sensitiveness, with a small pressure). In this condition

the light responded even to the exceedingly weak sound of the *primary* spark of coil, at the distance named.

When the gas is led to the lamp through a long rubber tube, offering considerable friction to its passage, the response is accompanied by a distinct jingling sound in the burner; and sometimes, as a secondary effect of the flame's motion, the whole mantel is seen to rock to one side when the spark is operated.

Methods of Engineering Instruction at Lewis Institute, Chicago.

The work in electrical engineering now done at Lewis Institute, Chicago, is rapidly assuming an important place among that done by the leading technical schools of the country. At the same time the institution seems to be meeting a demand in the educational line that has not heretofore been sufficiently appreciated and provided for. A brief review of the methods and work can hardly fail to be of value at the present time. These methods are due primarily to the efforts of Professor Philip B. Woodworth, to whom too much credit cannot be given for his skill in handling the class of men who apply to Lewis Institute for instruction. The classes at Lewis Institute are large, and especially is this true of the night school classes. All of the instruction is by laboratory work supplemented by lectures, and in this laboratory work, the great distinction between Lewis Institute and other institutions is that the apparatus given the students to experiment with is always something in practical every-day use rather than costly laboratory toys. Furthermore, the experiments, from the simplest elementary ones to the most elaborate tests, are all commercial tests. For example, the first thing a man is given to do is to test the efficiency of a common block and tackle and make a full report-sheet thereon. In this way the student gets his instruction in abstract science fully as well as if the experiments were made with purely laboratory apparatus, the cost is less and the instruction has the added charm to the beginner that he is doing something useful, not simply performing an experiment for the sake of abstract science. While abstract science may appeal to the trained scientific man more strongly than anything else, the same cannot be said of the average boy or young man in the beginning classes of an engineering school and even to those who love the work on account of their love for science, the fact that it is of a useful nature does not usually in any way detract from this charm.

In all departments the student's laboratory work consists of making a report to the instructor in charge on some piece of apparatus tested. The student is simply given the apparatus and the report blank and told to go ahead with the test, the instructor, of course, giving whatever personal supervision the student may need. In order to facilitate the handling of large classes and at the same time avoid cumbersome apparatus, Professor Woodworth has adopted 5-kw as the standard capacity of all dynamos, transformers, instruments or other apparatus purchased for laboratory use. There is then no trouble from "misfits" or with the instruments available not being adapted in size to the machinery to be tested, and the maximum usefulness can be got out of the apparatus at hand. Probably in no other technical school in the country does the ordinary student have so good an opportunity to handle and test apparatus. Indeed, it is a remarkable fact that a number of students who have graduated from electrical engineering schools and are at present in practical work are attending the night school classes at this institution in order to get practice in the handling of testing apparatus. As one of these students put it, "Here is where they let us handle the real apparatus; we were only allowed to look at it and told about it where I came from." Of course, in a laboratory of this kind the apparatus must all be of the portable commercial kind which will not be materially injured by inexperienced students' use. The laboratory, therefore, is not equipped with as remarkable apparatus in the way of fine scientific instruments as are the laboratories of many other institutions, but for the work it is laid out to perform it is unequalled.

It is in the night school classes of electrical and mechanical engineering that the most striking work is being done. During the past year there were 1128 night school students in electrical and mechanical engineering, and 600 in the day courses. The night school classes put in four hours a week in laboratory and lecture work, for thirty weeks in a year. Since changing from the old orthodox method of teaching physics to the present method (it is now called "engineering principles" instead of physics), the classes have practically doubled, and, as Prof. Woodworth puts it, "We have to drive the students out of the laboratory when their time is up, it is so hard to get them to stop." Day courses, giving the degree of M. E., after eight years' of work are offered. Encouragement is offered to advanced students who have pursued the full course, to do original investigation. Prof. Woodworth finds that graduates or members of correspondence schools make some of the best and most appreciative students in the night courses. The night school seems to fill a place between the university and the correspondence school, offering as it does the benefit of instruction and handling the actual apparatus to those who have no opportunity to take regular day studies and who feel the need of practical demonstration along with theoretical instruction. It further has in its advanced courses evident attractions, as is shown by its list of enrollments for students graduated from the regular technical schools who feel that they want more chance to handle and test apparatus than they were offered in college, or who may want instruction in advanced alternating-current work which has come up since graduation.

Self Revelations.

With the title "Industry's Magic Story; Labor Romance as Told by the Captains of America's Greatest Achievements," the *New York Herald* of Sunday, April 6, printed autobiographical sketches of a number of the guests at the recent "Captains of Industry" luncheon given at Sherry's, at which Prince Henry of Germany was the guest of honor. We reprint below the autobiographical portions of the sketches included of several gentlemen well known in the electrical field.

ELIHU THOMSON, LYNN, MASS.

The introduction to a sketch of Prof. Elihu Thomson states that the subject claims he is not a business man, so-called, but a professional engineer and scientist. His inborn tastes shaped his course from early childhood. Unless such compelling tastes existed, coupled with good judgment and energy in overcoming obstacles, success would not have been possible.

"Publicity," he has said, "interferes with study, with work, with usefulness in a large measure when it concerns careers" such as his. He does not seek and never has sought it, and says the same of "honors" and "awards." He repeats the saying that "when a man does anything of value, attracting public notice, all the world seems to conspire to prevent his doing more of it. Some credit me with being what I certainly am not—a typical American millionaire, etc.—under a mistaken notion that a man only becomes known by his financial or business success."

CHARLES F. BRUSH, CLEVELAND, OHIO.

Mr. Charles F. Brush says: "I was educated as a mining engineer, taking my first university degree in 1869. Believing there was a bright future for the professional chemist and metallurgist in the industrial arts, I followed this line of effort for several years. Time has long since proved my belief well founded, but its realization was too slow to warrant waiting. In 1877, after some years of study, thought and experiment, I gave up all other business and thereafter for many years devoted my time entirely to the invention and development of electric arc lighting on a commercial scale. This was an entirely new industry, and the attendant difficulties were great in consequence. The necessary inventions had to be made, patented and defended against piracy; the machinery had to be designed, experimented with and modified until it was reduced to the simplest and most efficient form, and the public had to be educated to the new light in the face of strong opposition from the gas companies everywhere. It was in the practical development of electric arc lighting that I achieved business success, and I attribute that success to the selection of a congenial and promising field of effort, followed by years of study and hard work, intelligently directed to a definite end."

FRANCIS B. CROCKER, NEW YORK.

Prof. Francis B. Crocker says: "In the first place, I believe a man should take up the profession or business he is most interested in and for which he possesses some talent. I believe this plan should be followed, even though it conflicts with family or social prejudices. A man should also prepare himself very thoroughly for his life's work, particularly if it is professional. Perhaps the most important quality is the ability and willingness to work hard. This does not necessarily mean an incessant grind from one year's end to another, but it

does signify that one must be keen after his duties and not in the slightest degree inclined to shirk them. It is only by doing the work of the man ahead of you as well as your own that one can be promoted. It is almost always foolish to avoid responsibility. This is bound to come to one and it is impossible to dodge it."

Reception at Columbia University to Lord Kelvin.

On April 21, the Monday following the installation of President Nicholas Murray Butler, the American Institute of Electrical Engineers and Columbia University will give a reception at the University in honor of Lord Kelvin and Lady Kelvin, in conjunction with the National Academy of Sciences, the American Association for the Advancement of Science, the American Mathematical Society, the American Physical Society, the Astro-Physical Society of America and the New York Academy of Sciences. To use the words of President Eliakim H. Moore, this event will be a "delightful expression of international scientific unity." The reception will be from 8:30 to 11 o'clock in the evening, with speeches by four eminent scientists, with a response by Lord Kelvin. Owing to the limited space in the reception hall, tickets to this reception at first will be issued only to members and one lady each. After the returns from the members for themselves, if the capacity of the hall will admit, guests may be invited by members. Persons desiring to attend the reception, who are not members of any of the above societies, will be given invitations by applying through members, if the capacity of the hall will admit. Entrance will be via the gate on 119th Street and Amsterdam Avenue. The executive committee for the reception are: Dr. Francis B. Crocker, chairman, Past President A. I. E. E., Member American Physical Society; Mr. Calvin W. Rice, secretary, chairman Committee on Meetings, A. I. E. E.; Dr. Robert S. Woodward, Past President A. A. A. S., Member American Mathematical Society; Mr. F. P. Keppel, secretary Columbia University; Dr. Arthur G. Webster, vice-president American Physical Society; Prof. J. McKeen Cattell, President New York Academy of Science, and Mr. T. Commerford Martin, Past President A. I. E. E.

Telephone Subway at St. Paul and Minneapolis.

The Northwestern Telephone Company has commenced, in St. Paul, Minn., the construction of a tunnel to connect the St. Paul and Minneapolis systems, and through which all of the interurban wires of the company will be run. The improvement will cost approximately $100,000 and will be completed before Fall. The object of the tunnel is to avoid interruption to the interurban service by storms, etc., and to give the company increased capacity between the two cities. There is no more pole room at present and the company is unable to supply the full service demanded by its patrons. Altogether the company will expend $500,000 in the Northwest this year in betterments of its plant. Of this amount $200,000 will be spent in extensions of the present underground system in Minneapolis and St. Paul, including the new interurban tunnel. Additions to the pole system, now under way, will cost $100,000 more; and the remaining $200,000 will be expended in the construction of additional toll lines, and in improvements of various systems owned by the company in northern Minnesota and the two Dakotas.

CURRENT NEWS AND NOTES.

NEW YORK CENTRAL TUNNEL.—Mayor Low has approved the bill providing for a change of motive power from steam to electricity in the Park Avenue tunnel by May 1, 1905, and giving to the New York State Railroad Commission the power to extend the time if it is made clear by the company that the change cannot be made in the period fixed in the bill.

WIRELESS TELEGRAPHY ON THE PACIFIC COAST.—A company represented by General A. W. Barrett is stated to be making active preparations for the installation of wireless telegraph stations on Catalina Island and in Los Angeles, Calif. The Marconi system will be used for communicating between these two points. The only wireless communication on the Pacific Coast at present is carried on between Ft. Mason, San Francisco and Alcatraz Island.

STATUE OF LIBERTY LIGHT.—At Washington, on April 3, Secretary Root said that he had decided to maintain a light in the Statue of Liberty on Bedlow's Island, New York Harbor, if he had the legal power to do so. Gen. Brooke, commanding the Department of the East at New York, will have a consultation on the subject with Secretary Root. There is an impression at the War Department that there is the same authority for lighting the statue, which is on a military reservation, that there is for lighting any other army post.

SUPPLIES IN MALTA.—Mr. John H. Grout, United States Consul at Valletta, Malta, in a report to the State Department says: The local government frequently advertises for bids for supplies, such as electric light carbons, tools, iron girders for structural purposes, printing paper, etc. The time for closing the bids is usually so short that I have never had an opportunity to report them for the benefit of our manufacturers. I would, however, advise such of our firms as have London representatives to instruct them to frequently pay a visit to the office of the Crown agent in that city, where bids for supplies for Malta are received.

A STORY OF RHODES.—One of the widest spread stories of the late leader of men, Cecil Rhodes, is that which credits him with having declared that he had never met a man whom he could not buy. This story is denied, and is said to be based on an expression of his which showed his confidence in his own powers of persuasion. When asked how he proposed to carry his Cape to Cairo telegraph across the Soudan, which was then under the domination of the Khalifa, he replied: "Oh, leave that to me. I never met the man yet that I could not come to an agreement with, and I shall be able to fix things up with the Khalifa right enough when the time comes."

TO SWITZERLAND BY WATER.—U. S. Consul Gifford, of Basel, sends, Feb. 27, 1902, the following description of a proposed all-water route from that city to the sea—the plan of a young Swiss engineer by the name of Gelpke: Basel is over 300 miles from Amsterdam, the nearest port on the North Sea. Mr. Gelpke proposes to render the Rhine navigable for freight steamers at all seasons of the year by regulating its water level. Beginning at the German frontier near Basel, he suggests the construction of fourteen dams, provided with suitable locks for the passage of vessels, and with sluices for driving turbines for the production of electrical power. It is estimated that the project would require $20,000,000 to carry it to completion, and that the turbines would yield from 100,000 to 150,000 horse power, which could be utilized by industrial establishments in Alsace and in the Grand Duchy of Baden.

THE TELEPHONE IN FIRE SERVICE.—In the course of an interesting article on Detroit in the *New York Sun*, it is said: Its fireboats are the most important part of Detroit's fire service. One guards the east water front of the city, one the west. Each carries 5000 feet of hose and helps at fires far back from the water front. A feature in connection with the pipe line part of the fire boat system is the telephone service, by means of which communication can be had from any plug on the line with the fire boats at the river. A small telephone apparatus is carried on each tug. This can be readily adjusted to any plug in the system, and the arrangement is of incalculable value. Through its operation the crews of the fire boats can be advised as to the progress of a fire at any point within their districts, so that the water pressure can be increased or diminished without the loss of time incidental to sending a message.

GERMAN-DUTCH CABLE.—A cable despatch from London of April 3 says: Details in regard to the formation of the new German-Dutch Cable Company are given by *The Times*. The company's headquarters will be at Cologne, and it will have exclusive rights to lay cables from Menado, the chief place in Northeren Celebes, to the Island of Guam, and thence to Shanghai, there connecting with the American Pacific cable. The company is to receive annual subsidies of $250,000 from Germany and $70,000 from Holland. The directorate is in part German and in part Dutch. It is believed, says *The Times*, that the treaty includes a secret protocol of a political nature. *The Times* says that the manner in which the Americans acted in regard to the cable to the Philippines is well remembered, and the Continent believes that if Great Britain became involved in a European war she would no more respect the neutrality of submarine cables than did the United States.

TROLLEYS AND POPULATION.—The new census of Berlin, Germany, gives the population at 1,901,567. The increase in population in the past year is only 12,857, as against 42,493 in the preceding year. This falling off in the yearly increase is attributed to the movement of the inhabitants to the suburbs as a result of electric traction.

INTERSTATE TELEPHONE CONVENTION.—According to the plans previously made, a convention of the Interstate Telephone Association is being held at Chicago as we go to press, viz., on April 9, 10 and 11. The headquarters are the Sherman House. The association is composed of independent telephone exchanges in the States of Illinois, Wisconsin, Michigan, Indiana, Kentucky, Missouri and Iowa.

WHY BOYCOTT MARCONI?—A special cable despatch from Berlin of April 3 says: "The *Lokalanzeiger* says that, under the existing statute, the Government can prevent the use of the Marconi wireless telegraph system on board German merchantmen, the erection of stations on the coasts of Germany, or the use of that wireless system in German waters. The paper suggests that the Government apply the law immediately." It would be very interesting to know how such a plan of obstruction can be justified. It would be worse than foolish.

POLITICAL CONVENTION BY TELEPHONE.—Farmers to the number of 200 in Kankakee County, Ill., listened to the speeches at the Kankakee County Republican Convention the other day without being present at the convention. These gentlemen were connected by the lines of the Central Union Telephone Company to the convention hall, and were able to sit in their homes from 15 to 36 miles distant, scattered over the county, and listen to the addresses. There are 1860 telephones in Kankakee County outside the city of Kankakee, or one to every 190 persons. This is said to be the largest percentage in the State.

THE BUCKET-SHOP TAX.—A special telegram from Washington of April 3 says: Another long conference on the War Revenue Reduction bill to-day resulted no more definitely than the last. It is certain that some very powerful influence is being brought to bear on both sides of the Capitol concerning the taxation of the so-called bucket-shops. Some powerful Wall Street interests are at work here in favor of the retention of the tax, and probably nearly as strong influences on the opposite side. No trustworthy predictions can be obtained regarding the outcome. It is believed here that the tax, if retained, can be made a very powerful weapon against certain classes of brokers who have not hitherto been supposed to fall within the scope of the law, and that if all of the other stock taxes were removed, thus relieving those affected by them of any misgivings in securing an absolutely rigid enforcement of the provisions of the law, there would be an effort to obtain such enforcement with the probable result of driving many individuals out of the business in which they are now engaged, or at all events of greatly hampering them. Hence a vigorous effort on the part of some to remove the taxes in order to give no advantage to the larger interests involved.

THOMPSON AND LODGE.—A cable despatch dated April 4 gives an extract from an article by Prof. S. P. Thompson, printed in the *Saturday Review,* and upholding the claims of Prof. Lodge as the original inventor of wireless telegraphy. Prof. Thompson expresses appreciation of Marconi's achievement in sending signals across the Atlantic, but ascribes the result to skilfully exploiting Lodge's invention. According to Prof. Thompson, neither Marconi nor Slaby is entitled to a patent on anything but the details of their systems, since neither of them can put himself in the position where Lodge stands as the original inventor. He adds: "The Slaby-Arco system is as much a lineal descendant of Lodge's earlier work as is Marconi's. Both of them employ Lodge's methods, inasmuch as both use a coherer to relay the Hertzian waves upon a telegraphic receiver, and both employ automatic tapper. Eliminate these features, which are due to Lodge, and both Marconi and Slaby collapse. So Marconi, who uses without acknowledgment these devices of Lodge, mouths out a denunciation of Slaby, who dares to use the same devices for the same purpose. It is a pretty quarrel. If Marconi imagines that his thin patent claims entitle him to a monopoly of the ether for the purpose of transmitting signals he is much mistaken. His dog-in-the-manger policy toward Slaby is simply silly, and the more so because neither of them can either transmit or receive a single wireless message in the United States without infringing on the patents of Lodge. It seems like the irony of fate that Lodge, the well-known principal of the University of Birmingham, after expounding the principles of wireless telegraphy in London and Oxford in 1894, should find himself pushed aside, first by the Italian, who by dint of advertising gains the public ear, and then by the German professor, and yet should actually stand master of the transatlantic situation because he holds the master patents in the United States. It is said that Lloyds has made an agreement with Marconi for fourteen years. Perhaps Lloyds is not aware where the patent rights lie. Marconi may whine as he pleases about other men snatching rewards from the scientific investigator. That is precisely what he himself has been trying to do in the last four or five years, his victim being the Englishman who was first in the field, and who, if he but knew it, is to-day master of the situation."

INDICATORS AND METERS.—Among the patents issued April 1 is one on means for preventing the creeping of meters, and another on an indicating instrument for use on alternating constant-current arc circuits. The first-mentioned patent, granted to A. D. Lunt, provides a dampening disk locally thickened at one or more places. The currents induced in such thickened portions react upon the magnetic field to which they are due and produce a repulsion, which opposes the passage through the field. By suitable adjustment or proportioning of the parts, this repulsion effect may be made just sufficient to overcome any creeping tendency which may exist. The second patent referred to was granted to Richard Fleming, and describes means to regulate alternating constant-current series arc circuits. In such circuits it has been found that the wave shape of the current supplied to the lamp varies with changes in the load, thereby affecting the working of lamps in circuit, and it is the aim of the invention to produce an indicating instrument which shall be responsive to changes in the wave form and also to changes in the frequency of the current, the latter also affecting the lamps. If the system be regulated to maintain a given deflection on the instrument, the current flowing will then at all times be such as to maintain proper voltage at the arcs. In a change of frequency of the source, the deflection of the indicating device is increased, and if brought back to normal will compensate at the lamps for such change of frequency, and the effect of change of wave form is similarly indicated and may be similarly compensated for by adjustment at the transformer. The current-indicating mechanism consists of a small transformer having its primary winding in series with the arc circuit, and the secondary winding connected through the winding of an inductance coil to a voltmeter. The core of the transformer and its primary are so proportioned that the iron is worked at a high magnetic density. Under these conditions, when the wave shape is changed the result will be less magnetization for a peaked wave than for a flat wave, even though the equivalent sine wave of current should remain unchanged. To overcome over-compensating effects for frequency, the inductance coil mentioned is used, which reduces to a proper amount the effect due to changes of frequency. A patent granted March 25 to Frank Conrad describes an instrument for indicating the phase and frequency relations of alternating currents and which has no moving coils. The instrument consists, first, of a laminated ring; second, a shell concentrically arranged within the ring, comprising a hollow cylinder of insulating material on which are wound two coils at right angles; and, third, a hollow coil within the cylinder. Also within the ring and on each side of the inner coil are semi-circular magnetic plates, the plate on one side of the coil projecting in a direction opposite to the plate of the other side. These plates are connected by a magnetic tube mounted on a shaft to which the indicating pointer of a dial is attached. The four leads from the two outside coils are combined to form a three-wire connection, and the three terminals are connected to three of the four conductors of the two-phase circuit to be indicated, thus securing a quarter-phase relation of e. m. f.'s. The stationary coil is connected to one circuit of the two-phase machine to be synchronized. The two coils at right angles produce a rotating field, and the inner coil produces a magnetic flux, the major portion of which is deflected by the two magnetic disks and the magnetic connection between the two disks. As a result of this condition the disk will take up a position corresponding to the difference of phase. The instrument may also be arranged to indicate the frequency relation as well as the phase relation, of any two circuits to which it is properly connected.

MORE FROM PROF. SLABY.—A cable despatch from Berlin of April 2 says: Prof. A. Slaby, the electrician, has issued a written reply to William Marconi's statement that he (Slaby) learned from Marconi what he knows about wireless telegraphy. The Professor says: "I have never omitted to mention, and at every opportunity have acknowledged, that I participated in the experiments carried on in May, 1897, by the English Telegraph Department, under the direction of Sir William Preece, with the Marconi apparatus of that day. But the present system of tuned telegraphy, as Marconi admits, has hardly anything in common with those primitive beginnings of 1897. The Slaby-Arco system is not based on those early experiments. On the contrary, as Marconi well knows, it is founded on discoveries that I published in December, 1900, to which Marconi referred in his address before the Society of Arts in these words: "I trust that it will not be thought that I desire to minimize in any way the importance of Professor Slaby's work." The very conspicuous change in Marconi's views, as contained in his letter published in New York, is something I very greatly regret."

LIGHTNING RODS are now under consideration of the Special Lighting Research Committee, which was organized last year by the Royal Institute of British Architects and the Surveyors' Institution. More than 200 competent observers have been appointed in the United Kingdom, the colonies, India, and elsewhere. The British War Office, the Home Office, the Post Office, the Trinity House Corporation, and the United States Department of Agriculture have agreed to furnish the committee with particulars of damage resulting from lightning stroke to buildings under their control. The net result, so far, is a series of seventy or more trustworthy records, which furnish promising material for the committee to work upon, with the view of formulating conclusions. The committee have arranged for getting photographs immediately after the occurrence of a disaster in cases of importance. Out of sixty cases tabulated up to the end of December, no fewer than twelve relate to buildings fitted with some form of lightning conductor. As regards the system recommended by the Lightning-Rod Conference of 1882, the facts at hand are not sufficient to determine the extent of its efficacy. The recently issued report, however, of the British Inspectors of Explosives goes to show that it has been found wanting, and that there is ample justification for the present inquiry.

LETTER TO THE EDITORS.

Mr. Marconi and His Critics.

To the Editors of Electrical World and Engineer:

Sirs.—So long as human nature remains pretty much what it is at present and apparently has been always, I suppose that one of the penalties of success, in whatever field of activity it may have been attained, will continue to be found in the subsequent forced endurance by the successful of whatever ill the rancor and disappointed spleen of outdistanced competitors may be powerful enough to inflict. Happily, however, this is not usually of very much account, and if ever a successful man was able to afford to consider the attacks of his unsuccessful rivals without anger and with some pity, I should imagine Mr. Marconi to be that man. After all, as one can easily conceive, it must be very, very annoying to Messieurs Slaby, d'Arco, Preece, Lodge, Thompson and the rest for whose arrows Mr. Marconi has lately in an especial measure found himself the target, really very annoying indeed, to feel themselves so utterly beaten in the race for success in wireless telegraphy, as they must do, I should suppose, in the privacy of their laboratories, however brave a face they may still strive to put upon it in the columns of the daily press. This consideration, however, though an explanation, can hardly be accepted as an excuse for the muddy torrent of press misrepresentation, to use no stronger term, which, since the *Deutschland* incident, has been let loose, principally from German sources, in the attempt—a very puny attempt, it must be agreed—to discredit Mr. Marconi and his system in this country. To that particular incident of the *Deutschland* and the wild vituperation and angry threats to which it moved Messrs. Slaby and d'Arco and their friends of the Allgemeine Electricitäts Gesellschaft, I think more prominence than they deserved has already been given by the press, but many of the statements current with regard to the affair have been so ridiculously beside the mark that, in the interests of accuracy, it may not be out of place that I should return to it in this place.

To mention first the bare facts of the incident itself: The *Deutschland*, as everybody knows, is the German passenger steamer which a few weeks ago was selected to have the honor of conveying Prince Henry on his voyage home from the United States. This steamer carries an installation of the so-called Slaby-d'Arco system of wireless telegraphy. I say "so-called" because Mr. Marconi has publicly expressed his opinion that the fundamental principles of that system are identical with those which he himself communicated to Professor Slaby some four or five years ago, when, at the request of the German Government, transmitted to him through the authorities of the British Post Office, he (Mr. Marconi), showed to Professor Slaby, who was his guest at the time for several weeks, the whole working of his system, so far as he had then developed it. If, therefore, as would appear from Mr. Marconi's statement to be the case, its details alone constitute the part of it for which the invention of Messrs. Slaby and d'Arco is truly responsible, it would seem to be doubtful how far it is appropriate to bestow a special designation of such nature upon what, on the above hypothesis, ought to be reckoned as a mere modification of the Marconi system, and, to judge by its results, a modification only for ill, at that. The point, of course, is one which cannot be finally decided in the columns of this or any other journal, but until the question of infringement is definitely settled by the proper tribunals, impartial persons will, I think, see that it behooves them to suspend their judgment as to whether anything to be fairly called a "Slaby-d'Arco system" is, in fact, in existence. The reason why the matter has not yet been raised is doubtless to be found in the slight importance attached by the Marconi Companies to the whole of the Slaby-d'Arco pretensions. Should these ever attain a more practical realization than any they have as yet reached; I mean to say, should the working of the system ever be extended by the efforts of the Allgemeine Electricitäts Gesellschaft or otherwise, to such a point as to cause the Marconi companies to consider an attack upon the validity of their patents to be worth their powder and shot, then undoubtedly the question will immediately be made the subject of rigorous test.

At present, however, no such degree of extension has been attained by the German system. The *Deutschland* is the solitary first-class passenger steamer which enters the port of New York—indeed, I might say, the only first-class passenger steamer in the world—carrying the Slaby-d'Arco installation. Nor is this a new installation, as one might well have supposed it to be, judging from the recent ebullition of wrath with respect to the steamer's disability to communicate with Marconi stations. On the contrary, I remember to have myself noticed her aerial wire as being arranged in a manner similar to that adopted by Mr. Marconi, when passing the *Deutschland* at her pier in New York harbor now nearly twelve months ago. I do not know how long before that the installation had been made and, I confess, it seems to me really a rather pitiable exhibition of Teutonic snobbery that until a German Prince happened to take passage on the ship, no particular public attention seems to have been paid to the disability in respect of wireless communication under which, of course, all along, her ordinary passengers have suffered. Be that as it may, the *Deutschland*, with Prince Henry on board, passed out into the ocean as usual without communication with Nantucket; made her voyage without any exchange with other transatlantic steamers, of messages such as frequently come to vary a little the monotony of the long sea days for passengers on vessels carrying the Marconi system; passed up the English Channel without speaking any Marconi station, and, as she approached Cuxhaven, the favored site of the lonely Slaby-d'Arco pole, was "jammed," it was alleged, by wicked persons sending Vs with wild persistence from a (purely imaginary) collection of sixteen transmitters stated to have been installed by the Marconi companies in Cornwall! Whereupon there arose in Germany a chorus of effervescent indignation, which quickly sped along the cables to the *Herald* office in New York, so that the American hardly less soon than the European public was treated to the unedifying spectacle of a learned professor, a noble Count and various other potent and distinguished personages alike, foaming at the mouth with a species of almost Berserk fury which, for brevity's sake, I will indicate as malignant Marconiphobia. And a very bad attack of it they had. To believe these gentlemen, nothing so uncivilized, nothing so "impolite," nothing, positively, so "inhuman"—dear Herr Professor!—had ever before been presented to the observation of a German Prince and of the German people, as the alleged refusal of those odious Marconi people (who, by the way, however, were never officially asked), to take in even the mes-

sage of a Hohenzollern when transmitted by Slaby-d'Arco apparatus. I hardly know what dreadful things in consequence were not going to happen to poor Mr. Marconi. One almost got the impression, indeed, that if the Kaiser did not forthwith order the German fleet to steam out, on the first really fine day, and shell Mr. Marconi's station at the Lizard, he would be doing something less than loyal Teutons had a right to expect from him! The whole thing was, in fact, as overdone as a German steak! Since, however, a doubt may have been left in some minds as to the exact relation of the Marconi companies to it all, I should like, so far as my information goes, to say a word or two on that point here. And, in the first place, let me mention that it is by no means clear that the *Deutschland's* failure to communicate with their stations on the occasion in question was exclusively to be set down to the hostile attitude of those companies. The contrary is, in truth, more than suggested by what occurred, according to the report which appeared in the *New York Herald,* sent direct to the paper from its own operators, at Nantucket. These operators, it seems, employed there by the *Herald,* and although their proceeding was in direct contravention of the *Herald's* contract with the Marconi companies, did in fact do their best to get into communication with the *Deutschland* on this famous voyage, and entirely failed, although, according to the testimony of that vessel's engineer, she passed so near that those on board her actually picked up the Nantucket light. This would seem to be a distinct evidence that the *Deutschland's* equipment of Slaby-d'Arco apparatus was not technically suitable for communication with a Marconi station, and that at least in one case, therefore, if Slaby-d'Arco could not work with Marconi apparatus the fault lay in the inherent unfitness of the former for the purpose. And, if this was proved in the case of one station, as it was in that of Nantucket, we may fairly conclude that the same experience would have been repeated had communication been attempted with the Marconi stations on the other side of the ocean, since these use for ordinary sea telegraphy installations in all respects similar to that employed at Nantucket.

But, however this be, as I understand the case, the Marconi companies would not at all wish to ride off on a side issue of such kind, and to the question whether the *Deutschland* would have been allowed to communicate through their stations, granting, for the sake of the argument, though the fact would seem to be the contrary, that she could, their answer has been a very unhesitating "No." I have not the honor of knowing Professor Slaby, except, of course, by repute, so I cannot judge how far a conjecture based upon his impassioned protest against the commercial spirit as applied to wireless telegraphy may be accurate. He has, however, I gather, ceased to have any commercial interest in what, if the *Herald* interviewer is to be trusted, he has himself described, rather suggestively, as the "exploitation" of the Slaby-d'Arco system, and there is, indeed, as we all must admit much to be said for the taking of short profits, since the practice has been known frequently to avoid the necessity of "cutting" a considerable loss. Professor Slaby's action in this respect has been marked, if I may say so without presumption, by a worldly wisdom and circumspection which I find it difficult to coordinate satisfactorily with this subsequent protest of his, which reminds one less of a man of affairs than of what one might expect from some mild, scholarly recluse among, it might be, those gentle dons of Oriel, who found themselves the other day referred to with such charming tenderness in Mr. Rhodes' will as being "like children in commercial matters."

Personally I happen myself to dislike in general that commercial spirit which so largely pervades contemporary life not less cordially than can, I think, even the most conservative of German professors. I recognize, however, as I think it might be recognized even by the latter, and as it must be recognized by everybody who looks the facts of existence in the face, that the class of enterprises which for their passage from the brain of the inventor to the service of the public require the expenditure of large sums of money and, naturally, in their earlier stages, at any rate, the taking of large risks by the parties who supply that requisite capital, is the very last class which could reasonably be expected to be conducted on other than strictly commercial principles. Professor Slaby apparently would reverse what, rightly or wrongly, has become in this connection the natural order of things. There is an English saying that trade follows the flag. It is even more certain that civilization, the modern brand of it, at any rate, such as it is, the civilization which, whatever it omits, as it omits much, does at any rate include a measure of the humanitarian element desiderated by Professor Slaby—it is even more certain, I say, that this sort of civilization follows trade. It would, no doubt, be all very well—for Professor Slaby, or rather, I beg pardon, for the assignees of Professor Slaby's commercial interests—that the Marconi stations should be thrown open to Slaby-d'Arco messages, and that free trade in wireless telegraphy, which is proposed so ingenuously by the chairman of the Allgemeine Electricitäts Gesellschaft, represents really a very charming and idyllic state of things which, were I financially interested in the success of the Slaby-d'Arco system, doubtless I should feel it my duty to do my utmost to promote. But at the same time I am sure I should expect a holder of Marconi stock to take a very different view and to insist with some pertinacity upon having from his directors a satisfactory answer to the vulgar question: "Yes, but where do I come in?" Seriously, the suggestion is absurd, for consider what the situation really is. Here, on the one hand, you have this so-called Slaby-d'Arco system with its one pole at Cuxhaven and its one—apparently not very workable—installation on the *Deutschland,* and, so far as I am aware, those two equipments indicate the limit of the system's present pretensions to free commercial development. And on the other hand, you have the Marconi system, which, apart altogether from its employ in the British and Italian navies and from its forthcoming undertaking of trans-oceanic work, is already, thanks to the genius of its inventor and the enterprise of his friends, in full commercial working upon some fifteen first-class passenger steamers plying to the port of New York alone, and at nearly forty land stations, established all, of course, at very considerable expense; a system which also, upon its merits, after a large expenditure of time and money upon the trials of other systems, has been selected exclusively for use by the Corporation of Lloyds at their telegraph stations—I think there are over 150 of them—throughout the world, through all of which stations as soon as equipped with the apparatus it must be remembered that the Marconi companies have right of way for their own messages. So that, in view of the fact that there is not anywhere in existence any corporation connected with the work of sea telegraphy and marine insurance to compare in importance with Lloyds, there would seem to be ample justification for the claim made by the Marconi directors in their last report that, for the present and during, at any rate, the fourteen years which their agreement with Lloyds has to run, their apparatus must be considered the standard apparatus for the ships of all nations.

It appears that the Kaiser's decree has gone forth in its favor and the Slaby-d'Arco system rejected by the British is to be used exclusively in the German Navy, which will thus, let us hope, find itself in good company, since from Professor Slaby's confidences to a *Herald* reporter the world learns that the said system is already in use in the navies—save the mark!—of Sweden and Norway, Denmark, and I know not what other world powers. I trust soon to hear that the Allgemeine Electricitäts Gesellschaft has placed an armed barge fully equipped with the Slaby-d'Arco system on a Swiss canal, in order that the list may be satisfactorily rounded off.

Truly, this German demand for wireless telegraphic free trade is explicable enough! But, so far from being "inhuman," it is, I fancy, very human indeed that the Marconi companies should see no reason at all why the Slaby-d'Arco people, who, as I notice that Mr. Marconi is reported to have remarked, very justly, have borne no part in the burden and heat of the day, the trouble and expense which it has cost them to get their own arrangements for sea telegraphy to their present advanced stage of development—should now come in as a matter of right, for that is the nature of their claim, and without the least recognition of the necessity of a preliminary coming to terms, or even so much as the suggestion of a thank you, merely to reap where Mr. Marconi and his companies have sown. It is really difficult to take such a proposition seriously. It is precisely as reasonable as would be the demand of a stranger who should have succeeded in tapping the circuit of a telephone company and ringing up the Central, to be connected with regular subscribers free gratis and for nothing. The suggestion has of course been made that Mr. Marconi's aim is to secure a monopoly of the ether, and that some international congress should be held for the purpose chiefly, it would appear, of restraining him therefrom. In the sense in which it is intended, the first of these suggestions is totally untrue, and on both points I certainly cannot do better than quote Mr. Marconi himself: "With any parties working a system," he has said, "which could prove itself to be workable without infringement of my patents—and that, I may say, I do not believe to be provable in the case of the Slaby-d'Arco system—we should at any time be willing to discuss the question of co-operation with a view to a mutual understanding upon

terms that should be deemed fair, in consideration of the advantages, enormous compared with any we could receive, which our long start of other competitors would enable us to offer under any such arrangement, and in view also of the common-law rights of the first comer." And with regard to the suggestion of an international conference, Mr. Marconi remarked further: "Nobody would welcome it more than I should myself, for the reason that I am quite certain that in no hands would the legal rights of the inventor—which are all that I claim—be safer or better protected."

I take it that these two passages convey a statement which is not only admirably clear as an exposition of Mr. Marconi's attitude, but meets also, fairly and squarely, precisely that which I think most unprejudiced persons will concede to be the justice of the case.

That for the present Mr. Marconi does possess a practical, as distinguished from that theoretical, monopoly, which apparently he has no desire whatever to claim, is due simply and solely to the sheer merit of his system, which to-day holds a position from which absolutely no serious rival is in sight. For that state of things Mr. Marconi's competitors have no one to blame but themselves. It is unfortunate for the dignity of controversy that some of them seem not to see that to abuse Mr. Marconi instead is a proceeding as vulgar as it is ridiculous.

New York City. Wilfrid Blaydes.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Induction Motor with Power Factor Equal to Unity.—Heyland.—An illustrated article, beginning with some historical notes. The first note on non-synchronous motor in which no phase-difference between current and e. m. f. existed under certain conditions, is due to Goerges in 1891; but his motor, although non-synchronous, did not belong to the induction motor type, but to the commutator motor type, "moteur de conduction" (as distinguished from "induction"); independently Latour has recently worked in the same direction; Latour's motor cannot be compared with the Heyland motor, except that there are superficial similarities. A motor which is more similar to Heyland's motor has been described by Blondel in 1896; this is an induction motor with short-circuited armature; it also has a direct-current winding with collector and is excited by a direct current supplied through two revolving brushes, the speed of which is equal to that of the field. The motor operates in a perfect manner; it has perhaps been too complicated to be introduced into practice. Heyland's present motor is distinguished by the feature that it has an armature short-circuited in itself—which is not the case with Goerges and Latour—and that it is excited by alternating current, which is not the case with Blondel. It is characterized by the typical arrangement of a conducting ring which closes the circuits of the winding, and serves at the same time for receiving the alternating current which is transformed into direct current. The adjoining diagram explains

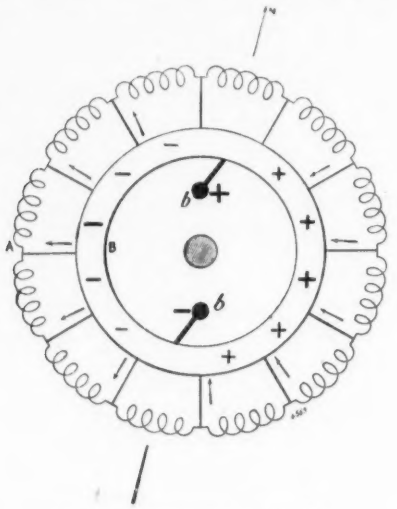


DIAGRAM OF HEYLAND MOTOR.

the action of the Heyland motor. *A* is a uniform winding, closed in itself at different points, although not directly but through the ring *B*. There are two brushes *b* to which are supplied single-phase currents or more brushes when polyphase currents are used, the frequency being that of the network. The figure shows two brushes which are sliding on the short-circuiting ring *B* and which are connected with the stator winding. *N* is the instantaneous position of the revolving field at a given moment. Under these conditions the revolving field produces currents in the rotor, the direction of which is indicated by the arrows in the figure. These currents do not produce magnetization or demagnetization, and are exactly compensated by the energy currents of the stator. The potential is distributed symmetrically on both sides of the brushes and is positive on one side and negative on the other, as indicated in the figure. If the resistance of the ring *B* is negligible, but has a certain value, the drop of potential corresponds approximately to the e. m. f. of the armature currents. The simplest arrangement which is sufficient for the demonstration of the theory, and which has been used in the first trial motors, is that represented in the adjoining figure, where two brushes are supplied from the stator with single phase alternating currents which changes the direction exactly with the number of the periods of the field so that the dissymmetry is always produced in the direction of the field. The brushes must then be fixed so that they have their maximum of e. m. f. in the position of the figure, where they are in the direction of the field. The resulting dissymmetry is oscillatory, but the pulsations of the e. m. f. do not prevent the magnetizing currents in the armature remaining practically constant. If the two brushes which are few with single-phase current, are replaced by several brushes, fed with polyphase currents, the principle of the arrangement is not changed. His method gives a constant excitation of the field in the armature, which excitation is practically absolutely equivalent to that which one would obtain by supplying direct current to the armature through two brushes; he concludes the article as follows: "The practical importance of the modification which is the subject of my invention, is best illustrated by the fact that at present, i. e., six months after the first publication, the construction has been adopted by the majority of the leading European firms."—*L'Eclairage Elec.*, March 22.

Armature Interference and Brush Position.—Hobart.—A continuation of his illustrated article. While it has been demonstrated that the reactance voltage may be made so low as to permit of departing altogether from the principle of using an impressed magnetic field to reverse the current in the short-circuited coil, he suggests now to go a step further, and, by using very low reactance voltage per segment, give the brushes a suitable negative (backward) lead, thus enabling the armature m. m. f. to supply, wholly, or in part, the desired compounding or over-compounding in proportion to the current output. With armatures of sufficient strength, estimated in terms of the armature ampere turns per pole piece, it is possible to dispense altogether with the series winding on the magnet poles and derive the compounding from the armature current. Such a machine would be characterized by an armature short in the direction of the shaft, and of large diameter, with very many rather narrow segments and generally but one turn per segment. The magnetic and current densities would be extremely high, chiefly for the purpose of obtaining the lowest possible reactance voltage; this would result in a machine of very moderate first cost, although of rather low full load efficiency; but the efficiencies at light loads would tend to be higher than in customary types. The reactance voltage may be still further decreased by having the armature conductors of stranded copper located at or near the armature surface. This could be arranged mechanically as strongly as if the conductors were embedded by having non-magnetic manganese steel, low conductivity disks pro-

jecting above the surface of the effective laminations at several points of the length of the armature. These disks would be constructed of such shapes as to, at the same time, serve to provide ventilating ducts at their sides. The non-magnetic disks would have suitable numbers numbers of equi-spaced slots, just like ordinary armature disks for slotted armatures.—Lond. *Elec. Rev.*, March 14.

LIGHTS AND LIGHTING.

Bremer Arc Lamp.—A description of the Bremer arc lamp placed upon the market by the British Westinghouse Company. Its light is of a much yellower and softer color than that of the ordinary arc. The arc proper is not controlled by varying the distance between the carbon tips, but the length of the arc is dependent upon the strength of certain electromagnets in its neighborhood. The carbons are made of a certain mixture of carbon and other materials. The carbons are almost parallel and vertical converging towards each other at the lower ends at an angle of about 20 degrees; they feed by gravity. The carbons are placed in the lamp by dropping them into brass tubes from the top of the lamp; there are no screws or clamps to manipulate. The carbon ends project through the lamp into the globe space for about 0.5 inch. A conical hood or reflector surrounds the carbon ends. The arc burns between the lower ends of the carbons inside of this reflector. It is prevented from traveling up between the sides of the carbons by a small electromagnet, the pole of which enters the hood between the carbons, and just above the arc, so that the arc is driven down to the carbon tips. The coil of this magnet is in series with the arc. Below the level of the carbon tips are the two poles of another electromagnet; these poles are placed outside the reflecting hood, and tend to drive the arc flame upwards. The lower magnet is compound wound, having a shunt circuit across the lamp and also a few opposing turns in series with the arc. The combined effect of a magnet blowing the arc downwards at the centre and a magnet blowing it upwards at the sides is to spread the flame into a broad fan shape. The reflector is of brass, but is soon coated with a white deposit from the vapor of the burning carbons, which makes an excellent reflecting surface. The carbons are not expensive and they are all consumed to within the last 0.5 inch or less. Moreover, the mechanical arrangement of the lamp permits the use of odd lengths or broken carbons. The arc is struck by a metallic contact piece which moves forward, and electrically connects the two carbon tips when current is switched on to the lamp. As soon as current passes through the carbons the striking piece is automatically withdrawn, leaving the arc across the carbons. Efficiency tests are said to have shown that a 12-amp. 44-volt lamp requires 0.126 watt per hemispherical c. p. when working without a globe. The same lamp with its globe on, all other conditions remaining the same, required 0.196 watt per c. p.—Lond. *Elec.*, March 21.

REFERENCE.

Nernst Lamp.—A short note on another Patent-Office decision against some broad claims of the German patents for the Nernst lamp. *Elek. Anz.*, Feb. 27.

POWER.

REFERENCE.

Testing of Tangential Type Water Wheels.—FARMER AND HENRY.—A reprint of an older illustrated paper, by Farmer, on impulse water wheels, with some remarks by Henry, on this paper.—*Jour. of Elec.*, February.

TRACTION.

The Electric Problem of Railways.—SWINBURNE.—A long abstract of a paper read at the Manchester section of the (Brit.) Inst. Elec. Eng. He considers the question of the different systems, not only in actual use, but of possible application. He discusses two cases of typical imaginary railways, one being a long main line, the other a line such as may be run in a "tube," having nothing but passenger trains and stations every half mile or so. He first discusses the latter case, in which acceleration and braking is the important consideration. He compares the use of direct-current series-wound, shunt-wound, and polyphase motors, at constant pressure and constant current. He mentions as a possible constant potential arrangement that the motor may be run at constant speed, and some sort of magnetic or fluid friction clutch applied. To get the advantage corresponding to that of putting two motors in series, the clutch must be arranged so as to couple through two different speed gears. There seems to be no advantage in applying such a system as this to direct current motors; but it gives the opportunity of using ordinary alternating current motors running at constant speed. The real demand is for a variable speed gear. The problem can be solved electrically; for instance, as proposed by Leonard, a constant speed motor may drive a variable pressure generator which feeds a variable speed motor; this arrangement is somewhat expensive, and involves three machines instead of one, or rather an extra double machine on each locomotive. It may be possible to arrange one motor-generator for each train, the train motors being on the multiple unit system; but this has nearly, if not all, the disadvantages of the locomotive system. He then discusses the current distribution on short lines. The first point is to settle the pressure; the present practice of using 500 volts is really due to the street tramway; there is no particular reason why it should be adopted for railways. In the second part of the paper he deals with the problem of long railways. The problem is entirely different from the former; acceleration is comparatively unimportant, and the energy is chiefly used for overcoming the train resistances. The capital cost in mains and sub-stations is greater in proportion to the traffic, as large proportions are frequently idle. It is therefore important to run light trains frequently. The constant pressure system with direct currents has the drawback of waste of energy during acceleration; but if the trains go long journeys, it is no longer important. The chief difficulty is the limit of pressure possible, but there should be no difficulty in making large railway direct-current motors for 1000 or 2000 volts. The direct-current constant pressure system has the great disadvantage of only suiting fixed speeds. This trouble can be largely overcome by making the motors large, so as to give a better acceleration, and running two motors either in series or in parallel. The series, constant, direct-current system has not the same advantages as in the case of a tube railway; the acceleration is no longer of vital consequence. With a given maximum pressure, and a given distance between sub-stations, the loss in the leads is greater, for the leads always carry the maximum current. The series system has compensations, however. It does not follow that because the motors are taken as limited to 2000 volts, that the line may not work at, say, 10,000. The difficulty here is that the motor must be insulated from the bogie, so as to stand high pressures; 10,000 volts with a maximum loss of 25 per cent, or 2500 volts, would allow a distance of 92 kilometers between sub-stations. This would generally mean that there would be no sub-stations, only generating stations, and they could be placed as a rule near large towns, so that they could supply their customers. The series system has the advantage of allowing any speed at high efficiency. It is preferable to brake by mechanical means instead of wasting time to slow down in order to get back a little energy. The three-phase constant potential system has some of the advantages of the constant pressure direct current. It falls behind in some points. There are three wires instead of two, and the motors cannot exceed their normal speed, however late a train may be. On the other hand, the system has the advantage that it can be worked for long distances, as frequent sub-stations can be put down, as they contain only machinery at rest. The distances between the generating stations are thus limited only by the economy of transmission at high pressure. The series three-phase system gives the same advantages as regards distance between central stations, but it is at a disadvantage compared with the constant pressure, three-phase system, as its advantage in acceleration is more than compensated by the need of having sub-stations with moving machinery for each block, with a motor-generator for each train that may be fed by the sub-station. He then gives some rough estimates of cost. He concludes that "it is advisable to pause a little before we convert our railways into electric street railways. We may, by doing so, not only work under drawbacks, which, though unavoidable in tramways, need not exist on railways; but we may stereotype a system which is found to be more and more unsuitable as the electrification of railways develops." It is most important that systems should not be adopted which prevent coupling up with other systems. What is most necessary is standard pressures and currents.—Lond. *Elec.*, March 14. A reprint of the paper in full is begun in Lond. *Eng'ing*, March 14.

Automobiles.—MUELLER.—The conclusion of his long mathematical article on the problem of utilizing the energy, generally wasted in braking, for recharging the batteries in an automobile. He shows that while this problem appears at first sight very promising, it is much less so when carefully considered. Only in a few special cases would the advantages of such an arrangement balance the disadvantages due to the compound motors required for this purpose. In general it is better to prefer series wound motors and to abandon the

idea of the utilization of the energy of braking.—*Centralblatt f. Accum.*, March 1.

REFERENCE.

Interurban Electric Road.—DAMON AND RAY.—An illustrated paper in full of their Chicago Elec. Ass'n paper on the Grand Rapids, Holland & Lake Michigan Rapid R'y.—*St. R'y Rev.*, March 15.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Los Angeles.—An illustrated description of the electric system of Los Angeles, Southern California. There are seven single-phase, 10,000-volt generators of together 1460-kw; two 200-kw, 500-volt, direct-current generators, and five 60-light, 9.6 amp. arc machines. The alternating current, supplying the suburban districts, is transformed up to 2000 volts. The distributing system is composed of alternating current lines for lighting service, 500-volt lines for power, constant current lines for commercial arc lights, and the municipal street lighting lines for series alternating constant current enclosed arc lamps. Los Angeles claims to be the first city in the world which adopted and used, exclusively, the electric arc lamp for municipal lighting; this was done in 1882.—*Jour. of Elec.*, February.

German Single-Phase Plant.—An illustrated description of the plant of Frankfort-on-the-Main which contains at present four single-phase alternators, each of 750-hp, and four, each of 1500. The load is approximately equally divided into a lighting system and a motor and traction service, the single-phase induction motors ranging from 0.1-hp to 50-hp, with 500-kw motor generators for the tramway supply. Connections are being made to supply over 5000-kw for power and about 7000-kw for lighting, and to meet this demand, two 4000-hp steam turbines are to be installed.—Lond. *Elec. Rev.*, March 14.

REFERENCE.

San Francisco.—An illustrated description of the Independent Electric plant in San Francisco. Two-phase currents are generated, three-phase currents transmitted to sub-stations, the distribution being by means of two-phase alternating and three-wire direct current.—*West. Elec.*, March 29.

WIRES, WIRING AND CONDUITS.

REFERENCE.

Submarine Cables.—BAYOL.—A very long illustrated article on the covering of submarine cables. He gives the general mathematical formulas and applies them to special numerical examples.—*L'Eclairage Elec.*, Feb. 22, March 8.

ELECTRO-PHYSICS AND MAGNETISM

Magnetic and Electric Deflection of Becquerel Rays and the Apparent Mass of the Electrons.—KAUFMANN.—An account of an investigation in which he determines the ratio of charge to mass and the velocity of the Becquerel rays produced by a small grain of radium bromide. Since the Becquerel rays are not homogeneous, a fine pencil of rays is broadened into a band when it is deflected. He uses the method of crossed spectra, allowing the electric and magnetic lines of force to act at the same time and parallel to each other, so that the two deflections are normal to each other. The fine pencil of rays thus traces a curve on a photographic plate placed normally to the direction of the rays, and in this curve every point corresponds to a definite value of the velocity and the ratio of charge to mass. The magnetic field was 299 absolute units and the electric field 44.3×10^{11}. The whole apparatus was enclosed in a completely exhausted glass tube in order to permit a measurable electric field to be used. The exposure amounted to 48 hours. The following set of figures gives some of the results, two figures always belonging together, the first figure when divided by 10,000,000,000 gives the velocity, the second when divided by 10,000,000 gives the ratio of change to mass: 2.83, 0.63, 2.59, 0.975, 2.36, 1.31. It will be seen that (as the charge of an electron is assumed to be a constant quantity) the mass of the electron increases with the velocity, "and this is in accordance with the theory, if the electron consists altogether or partly of apparent mass in the electromagnetic sense." He finally endeavors to calculate the ratio of the real to the apparent mass, and finds, for velocities which are small in comparison with the velocity of light, this ratio to be three.—*Goettinger Nachr.* 1, 1901; abstracted in *Ann. d. Phys. Beibl.*, February, and Lond. *Elec.*, March 14.

Ions in Gases.—MCCLUNG.—An account of an investigation of the rate of recombination of ions in gases under different pressures. The rate at which the ions recombine in ionized air is determined by the same law, no matter what the pressure of the gas may be, at least between the limits of .125 of an atmosphere and 3 atmospheres. The coefficient of recombination for the ions in air is independent of the pressure of the air for the same range of pressures. Hydrogen and carbon dioxide also behave like air.—*Phil. Mag.*, March.

Radio-Active Lead.—GIESEL.—An account of an investigation in which, from a large quantity of the mother liquor of barium-radium bromide, resulting from the industrial working of about 2000 kgr. of uranium ore, he separated about 3 milligrams of an intensely radio-active substance which behaved like lead and resembled preparations of radium in its action. After a year had elapsed, it still exhibited stray radiation. A spectroscopic examination showed that the spectrum was principally that of lead. Iron, magnesium, and a few other metals were also present, but lines of radium were absolutely wanting. He inclines to the belief that the lead owed its radio-activity to the quantities of radium with which it was associated in the original ore.—*Chem. News*, Feb. 21; abstracted in Lond. *Elec.*, March 7.

Effect of Magnetic Field on Resistance.—J. J. THOMPSON.—A note on the effect of a transverse magnetic field on metallic resistance. Everdingen has come to the conclusion that the theory that the electric current is carried by charged particles which move freely through the metal, requires the resistance to be diminished by a transverse magnetic force. J. J. Thomson had previously come to the opposite conclusion, namely, that the resistance on this theory ought to be increased. He now gives the reason for adhering to his original result. He thinks that some of Everdingen's assumptions are extremely unlikely.—*Phil. Mag.*, March.

Magnetic Expansion of Iron and Steel.—SHAW AND LAWS.—The conclusion of their paper, giving the results in diagrams and tables. Even if the chemical composition of specimens be identical, and they be annealed repeatedly from a temperature of bright redness, there is found to be an irregularity of behavior which indicates that the ultimate molecular structure is very heterogeneous; this is found under all possible variations of the experimental conditions. Regularity of expansion is obtained when a reading, under like conditions, has been repeated many times; this shows that the cause of irregularity is not in the measuring instrument, but in the particles which gradually take up a definite position under definite treatment. The irregularity is more noticeable in Swedish iron and mild steel than in hard steel. They observed a new and striking fact in the mode of expansion when current is switched on or off. Let H be the field required to give maximum elongation; if a field greater than H is applied, the rod first expands and then contracts; when the field is cut off, the rod expands again to its maximum, and then contracts to its stable state. Thus the rod undergoes every stage in expansion up to the point in question, and does not take a short cut, as might be expected.—Lond. *Elec.*, March 7.

Ionization of Liquids by Radiation.—CURIE.—An account of experiments in which he found radium rays and Röntgen rays are capable of imparting a conductivity to a liquid dielectric. All liquid dielectrics show an increase of conductivity by the action of both kinds of rays, but to prove this increase it is necessary that the original conductivity of the liquid should be small.—*Comptes Rendus*, Feb. 17; abstracted in Lond. *Elec.*, March 7.

REFERENCES.

Induction Coils for X-Light Tubes.—ROLLINS.—A long and well illustrated detailed description of the method of making a type of induction coil which he has found particularly satisfactory for X-light tubes and wireless telegraphy; and an explanation of the principles underlying the successful building of such coils.—*Elec. Rev.*, March 29.

Electric Oscillations of Higher Order.—LAMOTTE.—A mathematical note on electric oscillations of higher order, occurring in electric wave propagation over wires. He discusses the Drude-Blondlot, the Blondlot, and the Lecher exciters.—*L'Eclairage Élec.*, March 8.

Circular Filaments or Magnetic Shells.—LYLE.—A highly mathematical paper on circular filaments or circular magnetic shells equivalent to circular coils, and on the equivalent radius of a coil.—*Phil. Mag.*, March.

ELECTRO-CHEMISTRY AND BATTERIES.

Resistance Furnaces.—VOGEL.—A long abstract of an article giving some notes on resistance furnaces. He remarks that in many smelting operations the use of the arc causes a waste of energy; sometimes arc furnaces were at first adopted, but practice showed later that resistance furnaces were amply powerful. In resistance heating, it is

desirable that for a given cross-sectional area the electrode shall have the largest surface possible, short of making it mechanically weak. He gives the results of tests concerning the rate of oxidation in air of a carbon resistance. He says that if a resistance furnace for carbide is to work smoothly, it requires to be fitted with a set of electrodes arranged gridiron fashion; by this improvement a formation of crust still occurs, on the left and right of the grid, but not above it; and since the finished carbide constantly drops, by its own weight, to the bottom of the furnace in the shape of stalactites, the raw material on top is always free to descend to take its place.—Lond *Elec. Rev.*, March 14.

REFERENCES.

Furnaces.—BLOUNT.—A long abstract of a paper read before the Manchester section of the (Brit.) Inst. Elec. Eng. He gives a summary of the various substances which are or may be prepared in the electric furnace. The main considerations in the design of furnaces are the avoidance of waste of energy, the attainment of a sufficiently refractory chamber, and the arrangements for tapping off, or otherwise removing the products of the process. Electric furnaces are most suitable in districts rich in water power and poor in fuel. The paper does not seem to give anything new.—Lond. *Elec. Times*, March 13.

Ions and Electrons.—NERNST.—A French translation in part of his recent German lecture which has been noticed in the Digest.—*Gen. Gen. des Sc.*, Feb. 28.

UNITS. MEASUREMENTS AND INSTRUMENTS.

Test Coils for Alternating-Current Wattmeters.—BEATTIE.—An illustrated article. While it is generally recognized that most ordinary wattmeters are liable to read wrong when the power factor is low, he shows that by a very simple addition to a wattmeter which is inaccurate at low power factors, it may be made in a certain sense self-testing, so that the actual amount of the error can be easily determined at any moment by taking the difference between two readings of the instrument itself. This is based upon the principle that when the lag in the fine wire circuit is small—i. e., the reactance of the fine wire circuits small compared with its resistance—the formula representing the relation between the actual reading and the true reading becomes very simple; the actual reading being then a linear function of the inductance; hence the curves representing the wattmeter reading as function of the self-inductance in the fine wire circuit, become straight lines. If a few points of this straight line are found experimentally and plotted in a diagram, then the intersection of this line with the axis of zero inductance represents the true reading of the wattmeter. He gives a diagram with three such lines representing the results of an experiment made by introducing self-inductance into the fine wire circuit of a wattmeter, the total resistance of the circuit being adjusted so as to have the same value throughout. Instead of this graphical method he recommends providing a wattmeter with what may be called a test coil. This test coil would have its inductance carefully adjusted to equality with that of the wattmeter pressure coil, and may form part and parcel of the instrument itself, being so arranged that it will not directly affect the suspended coil when traversed by a current. By means of a two-way key either this test-coil or a non-inductive coil of equal ohmic resistance can be switched into the pressure circuit. With the test coil inserted the inductance of the circuit is just doubled, and the reading therefore altered by an amount exactly equal to the error. Thus, if on inserting the test coil, the reading should be increased by, say, 3 degrees, the true reading would be gotten by subtracting 3 degrees from the original reading. The method, of course, depends wholly upon the assumption that the reactance of the fine wire circuit be small compared with its resistance; but this should be the case in any wattmeter which makes any pretence to accuracy.—Lond. *Elec.*, March 14.

Measuring Inductance by the Speaking Arc.—JANET.—An application of the result obtained by Duddell, that if a direct-current arc is provided with a derived circuit comprising a condenser of capacity C and an inductance L, the arc under certain conditions gives a very pure note, having a period which depends in a very simple way on L and C. For capacities of 7 microfarads and feeble inductances, due to the coils of the circuit, the sound obtained is very shrill, and the alternating current intensity may be 20 or 25 effective amps. in the condenser circuit. Under these conditions, the present author measures with a thermal ammeter the current I in the derived circuit and with a thermal voltmeter the difference of potential E at the ends of the coil. Then, neglecting the resistance of the coil and the inductance of the rest of the circuit, he gets a formula which states that the inductance L is equal to C multiplied by the square of the ratio of E to the current I, so that L may be found by purely electrical methods and without any acoustic measurements.—*Comptes Rendus*, Feb. 28; abstracted in Lond. *Elec.*, March 14.

A New Electric Thermometer.—MESLIN.—An account of a method of measuring temperatures when it is not required to follow all the changes of temperature very rapidly. He uses the Clark cell; the temperature coefficient of its e. m. f. is pretty high, being about 0.5 per cent per degree, and the circuit may be so arranged that the observations are made by a zero method, and that the temperatures are measured in terms of resistance. In his arrangement the principal circuit contains two resistance boxes of about 30,000 ohms, an accumulator, and a double key, which enables the observer to close first the principal circuit and then the derived circuit, containing the galvanometer and the Clark cell. The resistances may be so arranged that 1 ohm corresponds to one-tenth of a degree, and fractions of degrees may be accurately measured.—*Comptes Rendus*, Feb. 17; abstracted in Lond. *Elec.*, March 7.

REFERENCES.

Wattmeters.—ARMAGNAT.—The conclusion of his illustrated article on wattmeters. He gives the principles of induction wattmeters and of electrostatic wattmeters. He discusses the correction required for exact measurements and gives a review of the different formulas. He finally discusses the effects of higher harmonics and describes the method of calibrating wattmeters.—*L'Ind. Elec.*, Jan. 25.

Testing Materials.—HOLITSCHER.—A long article in which he describes the methods applied by Lahmeyer & Company for testing the materials used for making electric machines and apparatus, and a general account of the results obtained with these methods. The article deals with the following subjects: sheet iron, wrought iron, cast steel, etc.; bare conductors, copper; insulated conductors; fuses; material for resistances; insulating materials; ammeters and voltmeters; meters; switches.—*Elek. Zeit.*, Feb. 20, 27.

Localizing Earth Faults.—MCDONALL.—An article on the final localization of earths on low-tension networks. The faulty section having been found by throwing off and testing section by section, the positions of the fault is determined fairly accurately by a loop test. As an example, he describes the procedure of localizing a fault on the negative of a three-wire system, with the middle wire permanently earthed. He also describes an extension of the test, for cases in which the disconnecting arrangements are difficult of access, or where all joints are permanent.—Lond. *Elec. Rev.*, March 14.

Measuring Insulation Resistance.—CHARPENTIER.—A very long, critical discussion of methods for measuring insulation resistance, and especially of the inherent disadvantages of the method in which the loss of charge of a condenser through the insulation resistance is measured.—*L'Eclairage Elec.*, Feb. 15.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Synchronizing Device for Telegraphy.—DUANE.—An illustrated, detailed description of a device for synchronizing the two motors which are used at the transmitting and at the receiving stations in certain kinds of multiplex and printing telegraphs, and in the picture telegraph. To keep each motor running at a practically constant speed, a device provides that when with increasing speed a certain speed is reached, the armature is short-circuited by means of the centrifugal force; when the speed decreases the short circuit is broken. When both motors are running at nearly the same rate, the speed of one or both is automatically varied so as to always keep them synchronized with each other. This is done by sending a small current over the wire, enough to work a sensitive relay; this happens for a small part of the time only, so that the wires may be used for telegraphing nearly all the time.—*Elec. Rev.*, March 15.

REFERENCES.

Private Branch Exchanges.—ZOPKE.—A well illustrated article on the Janus system. In Germany the Post Office, which has a monopoly of public telephony, allows five branch telephones to be used with each main telephone, the latter being connected to the line. Private telephones are not allowed to be connected with these public telephones; for a private telephone system separate apparatus and wires are required. The purpose of the Janus system is to use the same instruments for public and private telephony under guarantee of satisfactory control by the Post Office Department.—*Elek. Zeit.*, Feb. 20.

Telephone Exchange.—WORMULL.—An illustrated paper, read before the Newcastle section of the Brit. Inst. Elec. Eng., on "The Equipment of a Modern Telephone Exchange." An outline is given of three different systems, the last being the Western Electric common battery relay switchboard, in which both the signaling and speaking currents are supplied from the central energy station.—Lond. *Elec. Eng.*, March 7.

Printing Telegraph.—A well illustrated description of the Gilmore automatic printing telegraph.—*West. Elec.*, March 22.

Wireless Telegraphy.—REYVAL.—A continuation of his illustrated article on wireless telegraphy experiments in Germany. This part deals with Brann's system.—*L'Eclairage Elec.*, Feb. 1.

London.—The first part of a detailed and will illustrated description of the city exchange of the Post Office Telephone Department. This part deals with the underground cables, the street work, and the power plant.—Lond. *Elec.*, March 7.

Telegraphy and Telephony.—The first part of the quarterly review of progress and improvements made in telegraphy and telephony from October to December, 1901.—*Elek. Anz.*, Feb. 27.

Statistical.—Statistical articles on telegraphy and telephony in Germany in 1900, and in New Zealand in 1900.—*Jour. Teleg.*, Feb. 25.

MISCELLANEOUS.

Therapeutics with the Electric Arc.—BROCA AND CHATIN.—An article on the medical use of the arc between iron poles. Its crater is only slightly luminous and the chief luminosity proceeds from the gaseous arc itself. Another peculiarity which renders it specially fit for photo-therapeutics is the great intensity of the actinic rays when compared with the heat rays. This makes it possible to bring the diseased part within 8 c. m. of an arc of 20 amps. and 35 volts without interposing any cooling device. The absence of water further enhances the actinic effect. They have treated nine cases of Willan's lupus with the aid of the iron arc. An exposure of 15 minutes sufficed to produce a marked effect. Some 24 hours after exposure the healthy skin was found not to have been attacked, but the lupus nodules were profoundly altered, and replaced in most instances by excavations about 1 mm. in depth.—*Comptes Rendus*, March 3; abstracted in Lond. *Elec.*, March 3.

New Books.

HYDRAULIC POWER ENGINEERING. A Practical Manuel on the Concentration and Transmission of Power by Hydraulic Machinery. By G. Croydon Marks. New York: D. Van Nostrand Company. 360 pages, 201 illustrations. Price, $3.50.

This book is a short treatise covering the field of the generation and transmission of hydraulic power, and the change of hydraulic power into the required mechanical power. The author systematically gives, first, a short introduction to the general principles of hydraulics, flow of water, loss of head, etc., and then takes up the questions of hydraulic pressures, materials for machines, packings and valves. Having thus "laid down his raw technical material," he turns out the refined product—the various practical applications—in the same systematic way.

To those who consider the only use of hydraulic motors is to run coffee mills and old-fashioned elevators—pardon us, we should say "lifts"—a short perusal of the last chapter on "Recent Achievements" is recommended to remedy the error of their ways. As the actual concreteness of the flow of water as opposed to the intangible flow of electricity—not so intangible if you receive a full 550 volts through your arms—has certain charms for the British mind by reason of the massive size of the fixtures and the ponderousness of the machinery, it is hardly to be wondered that this sort of power has obtained a strong foothold in England. Not only in shipbuilding plants, but in engineering works of all kinds, development of hydraulic power is in a far more advanced state than in this country. However, the American engineer is making great use of hydraulics to-day, as witness the hydraulic dock of the Union Works at San Francisco, etc.

In view of the inefficiency of hydraulic power transmission, it is to be expected that in the future that for a certain class of work involving mechanical movements with a large *"M"* and a small *"V"* hydraulic machinery with motor-driven pumps will attract the attention of electrical engineers more and more to this subject. We can hardly doubt that all the large plants of the future will have one electrical generating station and be equipped in the various departments with motors supplying power to the machines by direct connection, gears, belts, ropes, or indirectly to the tools by the means of pneumatic or hydraulic power generated by motor-driven pumps. This consideration makes the book valuable as a text book to the student and as a manual to the electrical engineer, as well as to those, very few in number to-day, who are purely mechanical engineers

MANUAL OF ELECTRICAL UNDERTAKINGS AND DIRECTORY OF OFFICIALS. 1901-1902. London: Garcke. 976 pages. Price, 12½ shillings.

The sixth annual volume of this valuable British manual contains information relating to upwards of 1500 electrical undertakings owned in Great Britain and colonies by companies and municipalities. The aggregate capital represented is over $775,000,000, in which central stations and electric railways enter as follows: Central stations, companies, $92,000,000; municipalities, $95,000,000. Electric railways, companies, $200,000,000; municipalities, $12,000,000. The aggregate capital was increased by $160,000,000 during the year covered by the annual.

The following information is given concerning working capital and average rates of dividends: Telegraph, $150,000,000, dividends, 4.78 per cent; telephone, $45,000,000, dividends, 4.59 per cent; central stations, $72,000,000, dividends, 4.79 per cent; electric railways, $140,000,000, dividends, 4.29 per cent; manufacturing companies, $83,000,000, dividends, 6.81 per cent.

A section is given in the book to each of the central station, electric railway, manufacturing and other companies, which, in the case of the two former, includes a description of the system, a list of the officers and a financial statement for the year, covering capital expenditures, revenue account and balance sheet. In the case of central stations there are given the kw-hours of energy generated during the year, the respective amount used in public and domestic lighting, and the percentage of electricity sold to electricity generated. Also the rates at which current is sold, the number of public lamps, the total number of customers, the number of domestic lamps and the maximum load.

The book contains a large number of maps, showing the districts served and the location of generating and sub-stations, and the lines of electric railway. The map of the London District shows that there are 217 miles of electric railway constructed, authorized or projected in the metropolis.

A section on the progress of the year gives an account of the legislation relating to the electrical industry during the year 1900-1901, and various tables of statistics. A directory of officials contains over 4000 names of directors and officers of electrical companies. A large supplement shows by means of colors the results of the operation of central stations during the year covered. The black portion of a horizontal line indicates expense of generation, and is followed by a blue portion indicating expense of distribution; a yellow portion indicating rent, rates and taxes; a green portion representing management expenses; a white portion representing special charges, and a red portion representing profit.

To those interested in British electrical undertakings, this manual should prove simply invaluable, and it contains much of interest to the American reader, particularly with respect to central station and electric railway finances and statistics. While the American electric railway industry is represented by a similar book, it is very much to be regretted that there is no work of the kind devoted to American central stations. There would, however, be great difficulty in compiling a satisfactory book giving statistics of American central stations, since these are considered purely matters of private business, as in the case of other commercial enterprises. Massachusetts is, we believe, the only State which requires publication of central station business, and its requirements are far less exacting than those of the British Board of Trade, the records of which render possible the compilation of such an extremely satisfactory manual as the present one.

A CORRECTION.—In the title entry of the review notice of Wiener's "Practical Calculation of Dynamo-Electric Machines," which appeared in the issue of March 29, the price of the book should have been $3.00 instead of $2.50, as printed.

BOOKS RECEIVED.

ELEKTROMECHANISCHE KONSTRUKTIONEN. By Gisbert Kapp. Berlin: Julius Springer. 292 pages, 114 illustrations. Price, 20 marks.

CONTRIBUTION A L'ETUDE DES PERTES D'ENERGIE DANS LES DIELECTRIQUES. By Paul L. Mercanton. Lausanne: Imprimerie Corbaz & Company. 63 pages, 8 plates.

AN ELEMENTARY TREATISE ON ALTERNATING CURRENTS. By W. G. Rhodes, M. Sc. 211 pages, 83 illustrations. London: Longmans, Green & Company. Price, $2.60.

HIGH SCHOOL PHYSICS. By Henry S. Carhart, LL.D., and Horatio N. Chute, M. S. Boston: Allyn & Bacon. 433 pages, 322 illustrations.

A MANUAL OF PHYSICAL MEASUREMENTS. By John O. Reed, Ph. D., and Karl E. Guthe, Ph. D. Ann Arbor, Mich.: George Wahr. 185 pages, 86 illustrations. Price, $1.50.

THE ELEMENTS OF PHYSICAL CHEMISTRY. By J. Livingston R. Morgan, Ph. D. New York: John Wiley & Sons. Second Edition, revised and enlarged. 352 pages, 23 illustrations. Price, $2.00.

DIE ELEKTRISCHEN EINRICHTUNGEN DER EISENBAHNEN. By R. Bauer, A. Prasch and O. Wehr. Vienna: A. Hartleben. 431 pages, 318 illustrations. Price, 6 marks.

Directory of Electrical Societies, Etc.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual business meeting, New York, May 20; annual convention, Great Barrington, Mass., June 18-21, 1902.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Next meeting, Chicago, June 18, 1902.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Next meeting, September, 1902.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Quebec, June 11, 12 and 13, 1902.

INDEPENDENT TELEPHONE ASSOCIATION OF WISCONSIN. Next meeting, Waupaca, Wis., June 25, 26 and 27, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

NATIONAL ASSOCIATION OF MANUFACTURERS. Next meeting, Indianapolis, Ind., April 15, 16 and 17, 1902.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Cincinnati, Ohio, May 20, 21 and 22, 1902.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 25, 26 and 27.

OHIO STREET RAILWAY ASSOCIATION. Next meeting, June, 1902.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Salt Lake City, Utah, September, 1902.

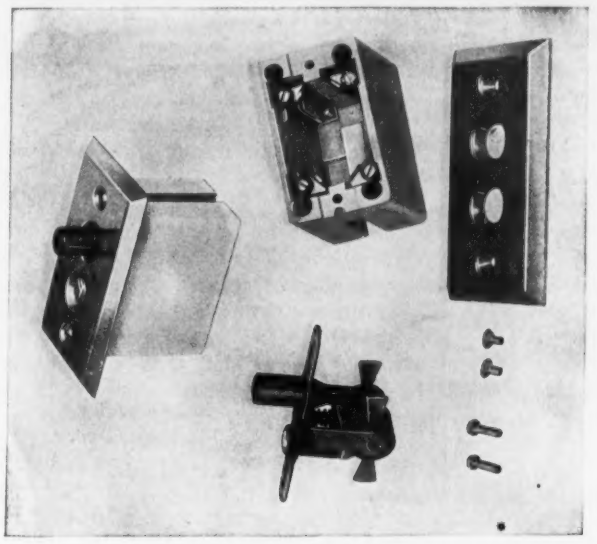
PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION. Next meeting, October, 1902.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION. Next meeting, San Antonio, Tex., April 18-21, 1902.

Push Button Flush Pocket Switch.

A complete line of single-pole, double-pole and three-way push-button flush pocket switches, is being manufactured by the General Electric Company. These are designed to meet all requirements for places where the maximum current is 10 amperes, and they are suitable for use on 250-volt circuits. They can, of course, be installed in the standard outlet boxes regularly manufactured for the reception of switches of this character. The mechanism, which consists of an unusually small number of working parts, is entirely enclosed in a substantial porcelain box. A quick make and break is one of the characteristics of these switches, and a liberal contact surface prevents heating.

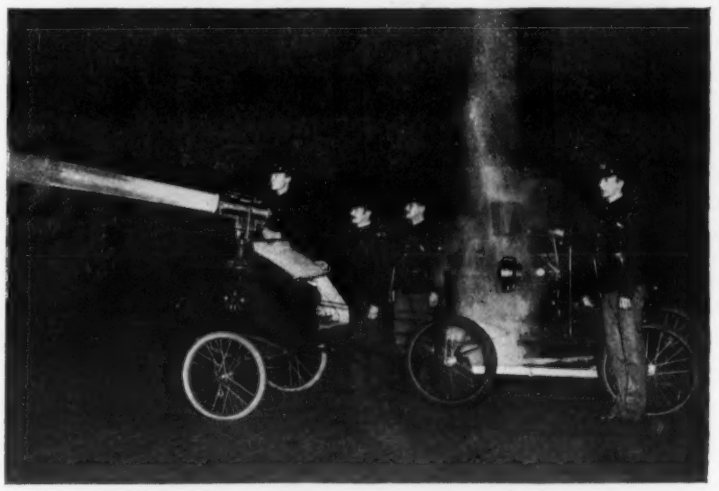
The quick positive action of the switch is accomplished by means of but one spiral spring which, with the other distinctive features of the switch, precludes any possibility of sluggish action or loosening of parts. One of the switch buttons is finished to correspond with the cover of the switch, while the other is black, so that a glance determines the position of the switch. The switch may be conveniently wired from the front after being placed in position. The standard finish adopted is nickel, but other finishes can be furnished. There is manufactured a cast iron wall pocket for use with these switches in connection with cleat or knob concealed wiring. Separate nickel covers are also furnished for the installation of two switches or three switches.



PUSH-BUTTON FLUSH POCKET SWITCH.

Search Lights in the New York State Signal Service.

At a recent inspection of the Second Signal Corps, N. G. N. Y., by Major General Roe, an interesting exhibit was made, showing the usefulness of an electric searchlight for army signals. The apparatus as devised by Capt. Baldwin and other members of the Corps consisted of an ordinary automobile operated by steam, and provided with a trailer carrying the searchlight and dynamo. When the searchlight is required to be put in service, the automobile is jacked up, and a belt from one of the wheels is connected with the generator, the engine on the carriage supplying the necessary steam power.



SEARCHLIGHT IN SIGNAL SERVICE.

The searchlight used is of the marine projector type, having a Mangin mirror. The lamp is automatic, with horizontal feed carbons, passing 10 amperes, and was built by Charles J. Bogue, 213 Centre Street, New York. This exhibit was successful in every way, and clearly demonstrated the fact that the automobile searchlight will greatly add to the efficiency of the signal corps in field and other operations.

Roller Bearings.

ROLLER BEARING.

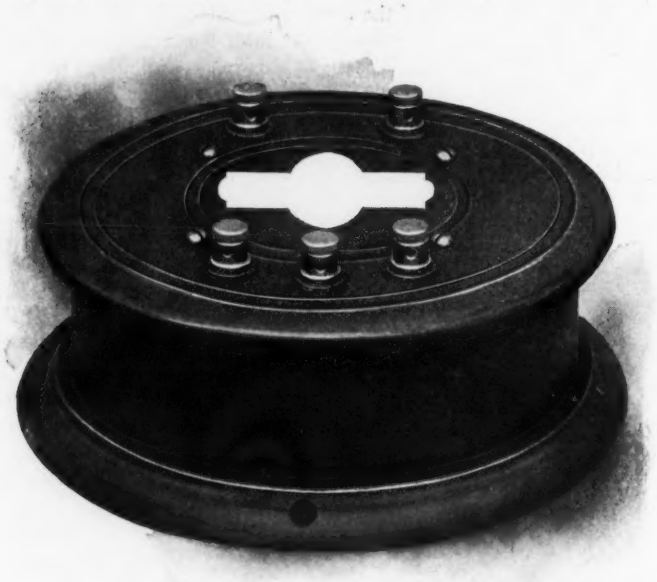
The American Roller Bearing Company of Boston is putting on the market a bearing having for its leading features rollers of very generous proportions; a system of separating rollers for preventing friction between the main or bearing rollers and for keeping them in perfect alignment; rolling supports for these separators, and an efficient system of bevels for taking the end thrust of the bearings. One of the greatest difficulties with roller bearings seems to be the inability to keep the rollers in alignment. The system used in this bearing depends upon the tensile strength of the separator to maintain this alignment. Another point of the bearing is the fact that a comparatively short roller is used. This reduces the possibility of breakage from twisting to a minimum.

The system is so planned that every part rolls in perfect harmony with every other part, thus avoiding rubbing friction. All rolling parts are carefully hardened and ground with extreme accuracy. These facts, combined with the liberal proportions of the rollers, give a bearing of great durability. The care required to keep the bearings in good condition is reduced to a minimum, as they do not require lubrication, but merely the use of a good rust preventive.

The company is devoting much of its attention to special applications of the bearing to heavy machinery and shafting, where the saving in power is sufficient to make the cost of the bearing insignificant in comparison.

The Adams' Secondary Generator.

Feeling that for heavy duty and continuous operatiin a demand existed for something more trustworthy and certain in its action than primary batteries, the Western Electrical Supply Company, of St. Louis, Mo., has recently perfected and is putting on the market a device which is claimed to be eminently convenient as a substitute, not only in regard to the matter of cleanliness, but particularly from its capacity for handling heavy work continuously without running



SECONDARY GENERATOR.

down and subjecting the service to occasional interruption. The principle is essentially that of a step-down transformer, but with numerous modifications in construction to render it particularly available for the purpose intended, and entirely suitable for the displacement of primary batteries in all localities where a continuous, 24-hour, alternating electric light service is maintained.

One type of machine will be found sufficient to handle the entire electric bell and annunciator system of the modern office or flat building, and consuming as it does about one watt of electrical energy in the 7200 alternations type, and about ¾ of one watt in the 133 cycle machine for continual operation, the running expense becomes a negligible quantity.

Another size of the machine, of twice the capacity, is designed for use on heavy electric door opener, annunciator, burglar alarm, gas lighter systems, and for small power purposes, such as supplying the necessary current for operating small, direct-current, toy motors, etc.

They consume from 1¼ to 1½ watts, and for heavy duty are claimed to be superior to any form of primary battery, either in regard to general convenience or low cost of maintenance.

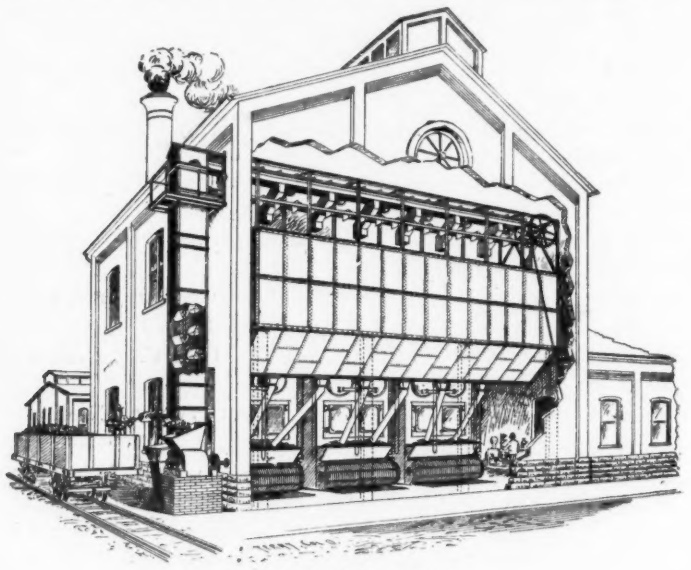
The magnetic circuit is so proportioned as to provide for a predetermined limit, being automatically set for the maximum secondary load, the $C^2 R$ loss at this point being kept well within the allowable limit, making overheating, under even the most severe short-circuit conditions, impossible, and at the same time preventing any chance of dangerous heating in the wiring and liability of fire from the same, as a result of any short-circuit conditions in the secondary circuits.

Annunciators, door openers, and in general all devices having a large number of turns, and consequently considerable impedance in the windings, usually require, on alternating current, somewhat higher pressures for their operation than is preferable for use with bells, and to meet this requirement the machines are each built to supply three secondary pressures, the load being taken in any proportions, from the various terminals. The machines are fireproof, and comply in every way with the requirements of the underwriters.

The Jeffrey Power Plant at Columbus, Ohio.

The Jeffrey Manufacturing Company's power plant at Columbus, Ohio, is a modern steel and brick fireproof building, provided with good light and ventilation. The boiler room is equipped with three 250-hp Babcock & Wilcox boilers, fitted up with chain grate stokers. The induced draft system is used in connection with the boilers and is put in in duplicate, thus making provision for any accident that might occur, allowing one to be shut down and the other started without any hindrance to the working of the boilers. Modern purifiers and feed water heaters are also features of the plant.

Another feature of the boiler room is the absence of the customary coal pile in front of the boilers. This is due to the storage tank of 280 tons capacity. The coal is unloaded directly from the cars into an elevator boat, or in case of lump or run of mine coal, into a crusher which is directly over the boat. The coal is taken to the tank by the



A MODERN POWER PLANT.

continuous Jeffrey bucket system. The tank is in direct communication with the stoker by means of chutes, provided with a gate valve, operated by a hand chain and wheel from the floor. The engine room is equipped with three 250-hp high-speed engines, belt-connected to three 150-kw, 250-volt Jeffrey generators. The switchboard is of black polished slate, especially designed and built by the electrical department to suit requirements. The power is furnished from this board to the different departments, which are electrically driven, the light and power lines being independent for each one.

An air compressor is also installed in the engine room which furnishes power for a number of pneumatic hoists and tools throughout the works. While this power plant is not very large, it is arranged to operate in the most economical manner.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Time money gradually became easier in tone and was freely offered, there being a light demand, however. The closing rates were 4¼ per cent for 60 days to four months; 4 per cent for six months. In the stock market there was increased activity, with advances led by the high-priced dividend-paying stocks. Amalgamated Copper was irregular, although there was a disposition on the part of inside interests to support it. The traction stocks were rather neglected, although there was talk of bullish manipulation in Brooklyn Rapid Transit. This stock closed at 65¾, being a net gain of 1 point, the sales aggregating 26,705 shares. Metropolitan Street Railway closed at 165, ex-dividend, which quotation represents a net loss of ¾ point, the total sales being 14,460 shares. General Electric was a strong feature. The recent buying of this stock, it is stated, is partly explained by the advance figures of the annual report, already published in these pages, showing earnings for 1901 which are equivalent to 32 per cent on the stock. The closing price was 325⅞, being a net gain of 3⅜ points, and only ⅛ lower than the highest figure of the week. Western Union made a net gain of ¼ point, closing at 90½; trading was light, however, only 1931 shares having been sold. Westinghouse Electric, both common and 1st preferred, made net gains of 4 points each, the former closing at 197½, and the latter at 201. Other closing prices are: American District Telegraph, 33; American Telegraph & Cable, 85½, a net decline of 1½ points, and American Telegraph & Telephone, 185, ex-dividend, being a net gain of 14½ points. In Boston American Telegraph & Telephone closed the week with a net gain of over 9 points. Following are the closing quotations of April 8:

NEW YORK.

	Apr. 1.	Apr. 8.		Apr. 1.	Apr. 8.
American Tel. & Cable..	84	87½	General Electric.....	321	325½
American Tel & Tel.....	—	183	General Carriage.....	⅞	⅞
American Dist. Tel.....	30	33	Hudson River Tel.....	—	—
Brooklyn Rapid Transit..	63⅝	65⅝	Metropolitan Street Ry..	162½	165
Commercial Cable.....	148	150	N. E. Elec. Veh. Trans..	—	1
Electric Boat.....	24	26¾	N. Y. Elec. Veh. Trans...	12	12⅜
Electric Boat pfd.....	45	45	N. Y. & N. J. Tel.....	—	—
Electric Lead Reduc'n...	1½	1⅜	Tel. & Tel. Co. America..	—	4½
Electric Vehicle.....	2¾	3	Western Union Tel.....	90¼	90
Electric Vehicle pfd.....	4¼	6⅞	West. E. & M. Co.....	194	214
			West. E. & M. Co. pfd...	197	215

BOSTON.

	Apr. 1.	Apr. 8.		Apr. 1.	Apr. 8.
American Tel. & Tel....	173	*183½	Mexican Telephone.....	2¼	2¾
Cumberland Telephone...	—	—	New England Teleph....	146¾	147
Edison Elec. Illum.....	—	—	Westinghouse Elec.....	—	—
Erie Telephone.....	—	—	Westinghouse Elec. pfd..	—	—
General Electric pfd....	—	—			

PHILADELPHIA.

	Apr. 1.	Apr. 8.		Apr. 1.	Apr. 8.
American Railways.....	—	—	Phila. Traction.....	97½	97⅞
Electric Storage Battery	76	74½	Philadelphia Electric....	4⅞	5½
Elec. Storage Batt'y pfd..	77	74½	Pa. Electric Vehicle.....	—	—
Elec. Co. of America....	7⅝	7⅝	Pa. Elec. Veh. pfd.....	—	—

CHICAGO.

	Apr. 1.	Apr. 8.		Apr. 1.	Apr. 8.
Central Union Telephone.	—	—	National Carbon pfd....	90	90
Chicago Edison.....	174	—	Northwest Elev. com....	39¼	37
Chicago City Ry.....	224½	220	Union Traction.....	18	19⅜
Chicago Telep. Co.....	—	*180	Union Traction pfd.....	—	—
National Carbon.....	24¾	24			

*Asked.

A NEW WAY TO FINANCE TELEPHONE COMPANIES.—The Co-operative Telephone Company, of Detroit, which is seeking a franchise in that city, has proposed a rather remarkable scheme for the floating of its bonds. The company proposes to raise $200,000 by subscriptions to its capital stock. It is estimated that at least $600,000, and probably more, will be needed to build the plant. The problem is to make $200,000 to do the work of $600,000. This is easy. After the $200,000 in cash has been raised from the sale of stock, this money is to be placed in the hands of some trust company acting as trustee for a bond guarantee company. The trust company is to invest the money in some reliable securities yielding 5 per cent. Bonds will be issued to the amount of $600,000, and the payment of these bonds will be insured by the bond guarantee company. The Bond Guarantee Company will have as security the $200,000 invested by the trust company acting as its trustee. This $200,000 at 5 per cent compound interest in thirty years is to yield the premium to the bond guarantee company, and the $600,000 which will secure the payment of the $600,000 in bonds, and it will make no difference to the bond guarantee company whether the telephone plant is in existence at the end of the thirty years or whether it is built at all. While this scheme secures the ultimate payment of the bonds, there is less to insure that the interest on the bonds will be paid than there would be in the ordinary method of issuing bonds. The amount paid in by the stockholders would represent nothing whatever in the way of tangible assets, as it would all go to insure the payment of the bond issue at maturity instead of going into the actual construction of the exchange. The amount invested in revenue-producing plant would, therefore, be less in proportion to the stock and bonds issued than by the ordinary method of procedure, and the chances for returns to both stock and bondholders proportionately less. At least, that is the way it strikes us.

ALBANY & HUDSON RAILWAY.—The plan for the reorganization rendered necessary by the unfortunate collision last summer, due to the gross carelessness of a motorman, calls for the deposit with the Colonial Trust Company of the existing securities ($2,500,000 each of stock and 5 per cent bonds, and 5 per cent notes given for coupons due Sept. 1, 1901) and the creation of the following new securities: (a) New series of bonds aggregating a total authorized amount of $1,800,000 of 4½ per cent, 40-year gold bonds, of which $1,500,000 par value are to be issued for the purposes of this plan and the remaining $300,000 are to be reserved to provide for future extensions, improvements and betterments. (b) The capital stock, now $2,500,000 par value, all of which is common stock, shall be divided into approximately $1,800,000 of 5 per cent non-cumulative preferred stock, preferred as to dividends, and also as to assets in case of dissolution, and $700,000 common stock. (c) The $700,000 new common stock shall be divided pro rata among the holders of the present $2,500,000 of capital stock. In case the new bonds are not marketed by the committee, the present bondholders will receive in new bonds 51.92 per cent of their present holdings—payment for the remaining 48.08 per cent being in preferred stock, amounting to $1,202,000 face value. In case the bonds are marketed by the committee, the present bondholders will receive for each $1,000 principal of old bonds $478 cash and $522 preferred stock. This agreement will only become operative when in the judgment of the committee, enough bonds and shares of stock shall have been deposited.

MINNEAPOLIS GENERAL ELECTRIC.—The earnings of the Minneapolis General Electric Company for the twelve months ended Feb. 28 compare with previous year's earnings as follows:

	1902.	1901.		Changes.
Gross	$431,958	$332,643	Inc.	$99,310
Expenses	199,252	164,135	Inc.	35,117
Net	$232,701	$168,508	Inc.	$64,193
Fixed charges	107,833	103,145	Inc.	4,688
Net profit	$124,867	$65,362	Inc.	$59,505
Improvement fund	30,000	30,000		.....
Surplus	$94,867	$35,362	Inc.	$59,505

Under a supplemental indenture, the company has agreed to expend out of earnings $30,000 per annum in improving the property or in purchasing bonds. The dividends on $750,000 of 6 per cent preferred stock call for $45,000 per annum, leaving $49,867 earned for the common stock during the 12 months ending Feb. 28.

DULUTH GENERAL ELECTRIC.—A trust deed of $1,000,000 was filed at Duluth by the Duluth General Electric Company and the Old Colony Trust Company of Boston, trustee. The mortgage is filed on account of the indebtedness of the company at present, and the additional obligation it will incur by the acquisition of an electric light plant in buying stock in the Prindle Gas Company, the Northern Electric Subway Company, and the West Duluth Electric Company, and by the purchase of materials for extension of the plant. The board of directors has been authorized to issue first mortgage bonds of $1,000 each for a sum not to exceed $1,000,000, to run for twenty-five years, the interest being 6 per cent.

BIG RISE IN WESTINGHOUSE.—On Tuesday, April 8, on the New York market a remarkable feature was the phenomenal advance scored by the shares of Westinghouse Electric & Manufacturing Company, the common jumping up 14½ points to 217½, and closing at a net advance of 12 points on dealings in 9700 shares, while the first preferred rose 15 points to 220 on transactions involving 1000 shares. There was no news to explain the rise, but the talk was that the company is earning something like 30 per cent on its capitalization. At the offices of the company the report of a consolidation with General Electric was again denied.

WESTERN TELEPHONE.—The advance in American Telephone has turned attention to Western Telephone & Telegraph Company securities and a number of the leading Boston houses are advising the purchase of these securities, especially the preferred stock. Theo. P. Harding in a special letter regarding this company points out that only about 40,000 shares of the preferred stock are in the hands of the public, 25,000 of which were distributed to old Erie stockholders upon payment of $100 per share and 10,000 shares were issued for the 5 per cent bonds of 1928 and 1929 in part consideration of their assent to the readjustment plan. Mr. Harding says: "In justice to the bondholders a dividend of 5 per cent per annum no doubt will be paid on this stock provided the earnings of the company will warrant. The net earnings of the company for 1901 may be placed at $1,400,000, from which should be deducted 5 per cent interest on the outstanding bond issue amounting to $500,000, leaving $900,000 applicable to dividends on the preferred stock, which at 5 per cent would amount to $800,000. It is believed that the net earnings of the Western Company for the year 1902 will be at least $1,680,000."

GENERAL ELECTRIC.—The General Electric Company has filed with the Massachusetts Commissioner of Corporations a report of its condition as of Dec. 31, 1901, as follows:

Assets:	Dec. 31. '01.	Dec. 31, '00.
Real estate	$533,959	$550,848
Cash and accounts receivable	16,014,553	13,339,127
Inventions and work in progress	8,449,664	7,330,832
Patents, etc	2,000,000	2,000,000
Plants, investments, etc	12,621,658	10,736,926
Total	$39,619,836	$33,957,733
Liabilities:		
Capital stock	$24,936,300	$23,750,000
Debts	1,814,607	1,599,179
Profit and loss	12,868,928	6,962,054
Total	$39,619,836	$33,957,733

SAFETY INSULATED WIRE COMPANY.—The Safety Insulated Wire & Cable Company, of which Leonard F. Requa is president, has been acquired by a syndicate formed by Messrs. Zimmerman & Forshay, bankers. The Safety Insulated Wire & Cable Company is one of the most prosperous insulated wire and cable manufacturing concerns of the United States. It has done a large business in furnishing cables to the Government at Manila. It has recently acquired large factory and water front properties at Bayonne, and installed the newest machinery to produce submarine cables of any desired length. Mr. Requa will continue in the board of directors. It is reported that the deal involves about $1,000,000. Mr. Max Osterberg has been active in the affairs as expert and representative of capitalists.

STROWGER TELEPHONES.—The following is a special despatch from Chicago of April 8: "A financial transaction of big proportions was announced to-day in telephone circles. The Government of Germany appears as the purchaser of patent rights covering all Europe except Great Britain, Ireland and France for an automatic switchboard manufactured in Chicago. The deal is the result of seven months' investigation in this city by a representative of the German Government. The electrical appliances will displace a telephone system of 40,000 instruments. Many operators will be forced to seek other employment, as one person can keep an entire system in order." This seems rather twisted, but it is said to be a fact that the German Government has taken up the Strowger system for Germany.

AN AMERICAN MARCONI COMPANY.—American capitalists, including Mr. J. P. Morgan, it is said, and represented by E. Rollins Morse, have secured the American rights of the Marconi Wireless Telegraph Company of London. The parent company retains a majority of the outstanding stock, and so has a controlling vote in the corporation's affairs. The new company, to be known as the Wireless Telegraph Company of America, will be capitalized at $6,150,000. It is stated that Mr. Marconi, on behalf of himself and English associates receives $250,000 and 55 per cent of the stock. The new company will operate in the United States, Cuba, Porto Rico, Danish West Indies, Alaska, Hawaii, Philippines, etc.

DIVIDENDS.—The Twin City Rapid Transit Company has declared a quarterly dividend of 1¼ per cent on its common stock. This is an increase of ¼ per cent quarterly. The first dividend on the stock was paid in August, 1899. In 1900, 3 per cent in all was paid. Since August, 1901, it has paid 2 per cent semi-annually. The Bell Telephone Company of Missouri has declared a quarterly dividend of 2 per cent. The Imperial Electric Light Company, of St. Louis, has declared a dividend of 2½ per cent. The trustees of the Street Railways & Illuminating properties will distribute $2 per share on the common on April 10.

GENERAL ELECTRIC STOCK.—A special meeting of the stockholders of the General Electric Company is called for Monday, May 5, at Schenectady, N. Y., for the purpose of voting upon a proposition to increase the capital stock by the amount of $19,757,800, to consist of 197,578 shares of common stock, so that the capital stock shall be increased from the present amount, $25,242,200, consisting of 252,422 shares of the par value of $100 each, to $45,000,000, to consist of 450,000 shares of the par value of $100 each.

EVERETT-MOORE PROPERTIES.—The Eastern syndicate that had an option on the Everett-Moore interests in the Toledo Railway has obtained a renewal of the option for fifteen days. The purchase of the Everett-Moore independent telephone lines in Stark County, Ohio, by public subscription has been assured. The price is $250,000.

TELEPHONE BONDS.—This week a deed of trust was filed by the Inter-State Independent Telephone & Telegraph Company of Illinois to cover $50,000,000 7 per cent 25-year bonds.

Commercial Intelligence.

THE WEEK IN TRADE.—Reports of trade to the mercantile agencies continue favorable, as heretofore. In the East and West retail trade was quieter, due to cool weather and the natural reaction from the ante-Easter activity, while heavy rains and floods have interfered with demand and movement in the South. *Bradstreet's* points out that there is the usual spring unrest in the leading industries, but the only important strike is that of the soft coal miners in Pennsylvania. Special promise of activity is held out this year in the building trades, and in the hardware trade country-wide activity is reported, the only difficulty being the obtaining of supplies fast enough. In iron and steel, strength continues. A contract for 100,000 tons of Bessemer pig for delivery in the fourth quarter is reported as about being placed at $17 a ton, valley furnaces. What sales were made during the week were at $17.50@$17.75, valley furnaces. Steel is scarce and billets are quoted at $32, which is $10 more than a year ago. The demand for finished material seems to be still in excess of the supply. Reports from Cleveland are to the effect that lake navigation having opened, iron foundries are crowded with orders and building is active. In coal, the usual spring reduction in anthracite (small sizes) is noted, but large sizes have been advanced. The business failures for the week, as reported by *Bradstreet's*, numbered 176 as against 183 the week previous and 188 the same week last year.

PAWLING & HARNISCHFEGER, Milwaukee, Wis., advise that the demand for electric cranes continues satisfactory. They have recently booked orders for 45 cranes and hoists, among which are representative firms, as follows: Henry Vogt Machine Company, Louisville, Ky.: One 5-ton, two 10-ton and one 15-ton. Oil Well Supply Company, Oil City, Pa.: One 2-ton. Wheeling Steel & Iron Company, Wheeling, W. Va.: One 7-ton. Allis-Chalmers Company (Fraser & Chalmers plant), Chicago: One 20-ton with 5-ton auxiliary. Allis-Chalmers Co. (Gates plant), Chicago: One 50-ton with 5-ton auxiliary. Bradley Manufacturing Co., Allegheny, Pa.: One 6-ton. Fairbanks, Morse & Co., Beloit, Wis.: One 15-ton. Colorado Fuel & Iron Company, Bessemer, Colo.: One 10-ton and one 20-ton. Newport News Shipbuilding & Dry Dock Company, Newport News, Va.: Two 20-ton. Whitney Iron Works Company, New Orleans, La.: One 10-ton and one 20-ton. American Bridge Company, Philadelphia: One 20-ton, double trolley. Pittsburg Plate Glass Company, Pittsburg: Two 3-ton. American Sheet Steel Company, W. Dewees Wood Company Department, McKeesport, Pa.: Two 5-ton. Structural Steel Car Company, Canton, Ohio: One 12-ton. The American Well Works, Aurora, Ill.: One 10-ton. Norton Emery Wheel Company, Worcester, Mass.: One 10-ton. Lackawanna Iron & Steel Company, West Seneca, N. Y.: One 3-ton. Follansbee Bros. Company, Pittsburg: One 5-ton, one 10-ton with 3-ton auxiliary, and one 25-ton. The Vulcan Works, Chester, Pa.: One 15-ton with 5-ton auxiliary. Northern Central Railway, York, Pa.: One 25-ton. The Midvale Steel Company, Philadelphia: One 10-ton jib. The Standard Steel Works, Burnham, Pa.: Five 5-ton and one 15-ton. American Sheet Steel Company, Wellsville Works, Wellsville, Ohio: One 30-ton, with 5-ton auxiliary. The Trenton Iron Company, Trenton, N. J.: One 3-ton. The William B. Pollock Company, Youngstown, Ohio: One 20-ton riveter, with 5-ton auxiliary.

THE HARTWELL ELECTRICAL COMPANY has been incorporated in New Orleans and has purchased the New Orleans Electric Company, the oldest electrical construction and supply house in New Orleans, and will carry a stock of supplies and engage in general construction, superintendence and electrical engineering. The personnel is Mr. C. A. Hartwell, president, and Mr. T. S. McLoughlin, vice-president and general manager.

VARIOUS BUCKEYE ENGINE ORDERS.—The Buckeye Engine Company, of Salem, Ohio, with New York offices, under the management of Mr. Paul Bigelow, 39-41 Cortlandt Street, has lately secured a number of substantial orders from various domestic sources for engines to be used for electrical purposes. The Southern Pacific Terminal Company, of Galveston, Tex., has ordered three 16½x30½x30 in. cross compound engines, each of which are to be direct-connected to 300-kw generators. The Allan Wood Iron & Steel Company's plant at Conshohocken, Pa., is to be installed with two 17½x30½x30-inch cross compound engines for direct connection to generators of 300-kw capacity each. Two 14½x25x24 Buckeye tandem compound engines have been requisitioned for installation in the St. Louis Glass Works at Pittsburg, Pa. These engines will be direct-connected to 150-kw generators. A 7½x12x12 simple engine direct-connected to a 50-kw generator is also to serve as equipment for the same Pittsburg plant. The General Electric Company works at Latrobe, Ohio, are to be installed with a simple 17½x21-inch engine for direct connection to a 175-kw generator. Wickwire Bros., of Cortlandt, N. Y., have sent in an order for a 15¼x26½x24-inch tandem engine to be direct connected to a 200-kw generator. A 16½x30½x30 cross compound engine to be direct-connected to a 300-kw generator will be furnished the Cleveland Woolen Mills Company, of Cleveland, Ohio. The American Steel Hoop Company has ordered for its Etna, Pa., plant a 17x30-30 cross compound engine to be direct-connected to a 300-kw generator. C. C. Mengel, Jr., Bros. & Company, of Louisville, Ky., have called for a 15¼x24 simple engine for direct connection to a 150-kw generator. Four 10x12-inch simple engines to be direct-connected to generators of 50-kw capacity each will be shipped the Standard Steel Car Company, of Pittsburg, Pa.

THE SPRAGUE ELECTRIC COMPANY reports among very recent sales the following orders for split-pole generators: E. L. Epperson Construction Company, St. Louis, 200-kw, engine type, 200 r. p. m., 550 volts; Chillicothe Street Railway Company, Chillicothe, Ohio, 300-kw, belted type, 450 r. p. m., 550 volts; Cosmopolitan Power Company, Chicago, 75-kw, belted type, 600 r. p. m., 250 volts; Ohio Powder Company, Youngstown, Ohio, 100-kw, belted type, 585 r. p. m., 500 volts; Keystone Leather Works, Camden, N. J., 200-kw, engine type, 200 r. p. m., 230 volts; Providence & Danielson Railway Company, Providence, 400-kw, belted type, 400 r. p. m., 575 volts; Board of Education, Chicago, two 150-kw, engine type, 225 r. p. m., 115 volts; E. W. Bliss Building, New York, four 150-kw, engine type, 225 r. p. m., 250 volts; Lackawanna Iron & Steel Company, Buffalo, 500-kw, engine type, 100 r. p. m., 250 volts; St. Joseph Railway, Light, Heat & Power Company, St. Joseph, 150-kw, engine type, 150 r. p. m., 200 volts; Otis Elevator Company, Yonkers, 50-kw, engine type, 290 r. p. m., 250 volts; The Wm. Tod Company, Youngstown, Ohio, 175-kw, engine type, 200 r. p. m., 230 volts; Railroad Construction Company, Princeton Junction, two 400-kw, belted type, 400 r. p. m., 575 volts; Sturges, Cornish & Burns, Chicago, 200-kw, belted type, 425 r. p. m., 250 volts; American Electrolytic Company, Rock Glen, N. Y., 200-kw, belted type, 550 r. p. m., 250 volts; Alfred F. Moore, Philadelphia, 75-kw, belted type, 600 r. p. m., 125 volts; Arlington Company, Arlington, N. J., two 75-kw, belted type, 460 r. p. m., 230 volts; one 62½-kw, belted type, 470 r. p. m., 230 volts; one 37½-kw, belted type, 500 r. p. m., 230 volts; Adams & Westlake, Chicago, 125-kw, engine type, 250 r. p. m., 250 volts.

NEW CUTLER-HAMMER SHOPS.—The Cutler-Hammer Manufacturing Company, of which F. R. Bacon is president; H. H. Cutler, vice-president; A. W. Berresford, secretary; and F. L. Pierce, treasurer, has consummated a transfer of real estate at Milwaukee with F. A. W. Kieckhefer, of the National Enamel & Stamping Company, which gives the former possession of the entire block bounded by Twelfth Street, Thirteenth Street, St. Paul Avenue and the Chicago, Milwaukee & St. Paul Railroad tracks. The Cutler-Hammer Manufacturing Company has its plant on a portion of this property and the additional space will enable it to construct buildings which will more than double its present capacity. The company now employes about 250 hands, but the business that could be handled were it in a position to do so, would mean the employment of upward of 500 men and steps will immediately be taken to enlarge the plant, which will eventually cover the entire block. The Cutler-Hammer Manufacturing Company is one of the very largest manufacturers of electric motor controlling devices in the world, shipping products to all quarters of the globe.

HARRISBURG ENGINE ORDERS.—The Harrisburg Foundry & Machine Works, New York offices, 203 Broadway, under the management of Mr. W. P. Mackenzie, reports receipt of an order for a 220-hp Harrisburg standard engine for direct connection to a 150-kw Westinghouse generator. This equipment will be installed for general power purposes in the Carteret, N. J., plant of the Chrome Steel Company. The George A. Fuller Company, 135 Broadway, has requisitioned for a 150-hp Harrisburg standard engine for direct connection to a 100-kw General Electric generator to be used for lighting the Union Club, New York City. Mr. James McKane, of Coney Island, has ordered a 90-hp standard engine for direct connection to a 60-kw generator—make not yet decided on—for installation in the Seaside Athletic Club, Coney Island. An order has also been secured by the Harrisburg people for a 60-hp standard engine to be direct-connected to a 35-kw generator—not yet ordered—which will serve for lighting the new Rahway, N. J., chemical works of Merck & Company.

A LARGE ORDER FOR ARCS.—Probably by far the largest order ever given for arc lamps—certainly the largest for enclosed arcs—is that recently secured by the General Incandescent Arc Light Company, of New York City, from the Cincinnati Gas & Electric Company. The installation will consist of about 4500 "G. I." series alternating current lamps of the enclosed type. These will be divided into circuits of 60 lamps each, connected to 75 automatic transformers and controlled from a switchboard consisting of 75 panels, with ammeters, switches, lightning arresters, kicking coils, etc. The contract was entered into early in January and the first instalment of over 500 lamps has already been shipped. The contract calls for complete delivery of all the apparatus by June. The tests have been very satisfactory, and although such an order, on top of a great volume of regular business, has taxed the productive resources of the G. I. factory, it will be delivered on time.

LAWRENCE PUMPING OUTFITS.—The Lawrence Machine Company, of Lawrence, Mass., reports receipt through its New York representative, Mr. H. E. Maxfield, of 39 Cortlandt Street, of an order for a double suction centrifugal pumping outfit of 15,000,000 gallons' capacity for installation in the new Mount Washington Hotel, Mount Pleasant, N. H. The pump is to be direct-connected to an alternating current motor which is to be utilized also for various other purposes. The motor will be furnished by the Westinghouse Electric & Manufacturing Company. The Georgia Railway & Electric Company, of Atlanta, Ga., has just requisitioned for a 30,000,000-gallon pumping equipment. This pump will be direct-connected to a direct-current 50-hp motor of Westinghouse build. The outfit will be installed in the Southern Company's central power station.

TELEPHONE ENGINEERING WORK.—It is understood that important changes are being made in the engineering department of the American Telephone & Telegraph Company. It is proposed to have the Bell engineering work of the parent organization consolidated in Boston, having thus in one organization the control of all engineering matters in which the company is interested directly. The aim is to establish a condition of things which will result in standardizing and simplifying telephone engineering questions throughout the country, so far as these may belong to the company's jurisdiction or be submitted to it for advice and suggestion. The details are now being worked out. It would appear from this that for some time to come Boston will remain the actual Bell headquarters.

WESTINGHOUSE EQUIPMENT FOR MERSEY TUNNEL.—The Westinghouse Machine Company from its East Pittsburg shops will next week make shipment of an important lot of equipment to be installed in the power station of the Mersey River Tunnel Railway, between Liverpool and Birkenhead, England, the contract for the electric conversion of which system was recently awarded to the British Westinghouse Electric & Manufacturing Company, Limited. The shipment will consist of two 2000-hp Westinghouse vertical cross-compound engines and the same number of Westinghouse generators of 1200-kw capacity each, for direct connection with same.

THE BUFFALO FORGE COMPANY, Taylor Building, Cortlandt Street, under the management of Mr. J. J. Lyle, M. E., has been allotted an order by the Bowery Bay Improvement Company, of North Beach, L. I., calling for a 280-hp engine, which it to be direct connected to two Stanley alternating-current generators of 90-kw capacity each. The Northern Engineering Company has requisitioned for a 10x10 Buffalo engine, to be direct-connected to a 35-kw Elwell-Parker generator. This outfit is intended for lighting purposes by Conrad Eurich & Company, Brooklyn.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, will, within a few days, ship to Seattle, Wash., four batteries of chloride accumulators. One of these will be installed in the power station of the Seattle Electric Company for use with the railway machinery as a regulator of the fluctuating load and as a reserve. The three remaining batteries are for use on the Seattle & Tacoma Interurban Railway, and are to be used for regulating the great variations in load on this system.

BALL ENGINE ORDERS.—The Tennessee Copper Company has recently installed a tandem compound engine, direct-connected to a generator, in its plant at Isabella, Tenn. The Ball Engine Company, Erie, Pa., furnished the engine. The School for Deaf at Devil's Lake, N. D., is about to install an electric plant, consisting of a Northern Electric generator direct-connected to an engine built by the Ball Engine Company.

General News.

THE TELEPHONE.

CARROLLTON, GA.—The Gainesboro Telephone Company has built long-distance lines into thickly populated points in Carroll, Haralson and Paulding counties, Ga., which are under control of the home office at Carrollton, Ga. It has begun a line to Roopville, and arrangements have been completed for an exchange in connection with the long-distance service at Dallas, Ga.

OSMAN, ILL.—The Rantoul telephone line is to be extended to this place.

CHAMPAIGN, ILL.—The Home Telephone Company, in Champaign, will improve its plant.

OQUAWKA, ILL.—At a meeting of the County Board of Commissioners three telephone franchises were asked for and granted: The American Telephone & Telegraph Company; The Carman Farmers' Telephone Company, and another company, of which George Chandler is president.

INDIANAPOLIS, IND.—R. J. Williamson, Ed. Taylor and D. N. Reed are the directors of the Montmorenci Telephone Company, incorporated with $3,000 capital, to operate in Tippecanoe and White counties.

INDIANAPOLIS, IND.—The Dolan Telephone Company, with headquarters at Bloomington, which will operate in Monroe, Morgan, Brown, Owen and Greene counties, has been incorporated with $5,000 capital stock.

INDIANAPOLIS, IND.—The Ohio River Telephone Company, of Rising Sun, has been incorporated, capital stock, $45,000; directors, William M. Calvin, R. and W. M. Green, Jr. The company will operate in Dearborn, Ohio, Switzerland, Jefferson and Ripley counties.

MARION, IND.—The Merchants' Association, at a recent meeting, appointed a committee to see that every member of the association takes out the Bell telephone and use only that of the United Telephone Company. The merchants have come to the conclusion that one telephone is enough, and as the franchise of the United Telephone prevents an increase in rates the merchants have decided to use this system exclusively.

ELWOOD, IND.—Work has begun on the plant for the new telephone company in this city, which is to form a part of the independent combination which was recently granted a franchise by the City Council. A large force of men is employed and the plant is expected to be in operation within six months. Simultaneously the construction of ten miles of telephone lines, to reach farmers north of town, was begun. The company includes some of the wealthiest farmers of that section, and one hundred rural telephones will be put in at once. This line will be connected with the Elwood exchange.

EVANSVILLE, IND.—The sentiment in favor of municipal ownership is sufficiently strong here to culminate in a scheme to install a municipal telephone plant to cost $250,000. The scheme originated with the Mayor, City Attorney and members of the Board of Works, who propose to organize a company to operate a new plant to be installed by issuing $200,000 of preferred stock to draw 3½ per cent payable semi-annually. The city is to receive $250,000 of common stock in consideration of a franchise, the interest on said stock and other profits to be used in retiring the preferred stock and thus in time the city will own the plant. Subscriptions are now being taken for the preferred stock and a wave of sentiment for municipal ownership is sweeping over the city. Evansville owns its water plant, from which it derives $50,000 profits each year and, it is claimed, that a telephone plant will do better.

NEVINVILLE, IA.—A telephone company has been formed at Nevinville.

OELWEIN, IA.—The Cedar Valley Telephone Company will rebuild the Oelwein system this year, at an expenditure of $5,000.

OTTOSEN, IA.—The Farmers' & Merchants' Mutual Telephone Company, capital, $10,000, has been incorporated by L. J. Clave and others.

CENTER JUNCTION, IA.—The farmers residing between Center Junction and Onslow have organized a telephone company and will build a line between both towns.

FORT MADISON, IA.—The Lee County Telephone Company has been incorporated here, with a capital of $1,200. The incorporators are H. D. Everingham, H. F. Benbow and Albert Benbow.

TURKEY VALLEY, IA.—The Turkey Valley Telephone Company, of Wiota, has been incorporated with a capital stock of $10,000. The incorporators are O. Coomes, R. E. Daughenbaugh, L. A. Engle and C. V. Beaver.

ELTZEN, LA.—The farmers southwest of Eltzen have organized a mutual telephone company. They will run a line between Dorchester and Eltzen.

MONROE, LA.—The Monroe Telephone Company held a meeting to consider an offer to sell out to the Cumberland Company. A board of liquidation was appointed. Mayor A. A. Forsythe also undertook to organize a company to purchase the plant of the home company.

PORT HURON, MICH.—Articles of association of the Capac Telephone Company have been filed; capital stock, $3,000. Incorporators, Robert Morrison, John P. Willoughby, W. H. Sturgis and E. J. Buck.

MINNEAPOLIS, MINN.—Mr. D. N. Tallman, of Willmar, Minn., president of the Minnesota Central Telephone Company, has completed arrangements for the expenditure of $250,000 in betterments for his company. The Minnesota Central Company is a consolidation of the Southern Electric Telephone Company, the Northern Electric Telephone Company, the Western Minnesota Telephone Company and the Minnesota Electric Telephone Company, and its lines cover an extensive territory in Minnesota, from Bemidji on the North to New Ulm and Sleepy Eye on the South, and from Minneapolis to the Dakotas. During the past few months, Mr. Tallman says, the company has experienced a very satisfactory growth, and there is a constantly increasing demand for its services in the small towns of the State. To meet this demand and to improve its facilities and add to the satisfaction of its patrons, $250,000 will be spent this year. It is the intention of the company to install copper metallic circuits throughout the various lines and to make many improvements in its local exchanges, of which there are about thirty in various parts of the State. The company is now operating about 2000 miles of toll lines in Minnesota.

MADISON, MO.—Emmet Weston has bought the Lasbury telephone line and will soon make some improvements on it.

DAVENPORT, MONT.—John Hausen has obtained a telephone franchise for Davenport, and is putting in an exchange. Lines will be run to Mosow, Mondovi and Reardon, where exchanges will be installed.

BOULDER, MONT.—The Rocky Mountain Bell Telephone Company has contracts for 35 telephones to be connected with the long-distance system at Boulder. The line will be greatly extended in the spring.

BOZEMAN, MONT.—The West Gallatin Telephone Company, with headquarters at Bozeman, has been incorporated with a capital of $10,000. Directors, E. B. Martin, E. C. Kennedy and W. L. McDonnell, all of Bozeman.

OMAHA, NEB.—The Iowa & Hilton Township Telephone Company, of Conroy, Ia., has been incorporated, with a capital of $10,000, by John Ahrens and others.

NORWOOD, N. Y.—A franchise has been granted by the village to a local company to put in and operate a telephone system during the coming summer.

ALBANY, N. Y.—The Frontier Telephone Company, of Buffalo, has filed with the Secretary of State a certificate of increase of capital stock from $500,000 to $3,000,000. The certificate is signed by Elgood C. Lufkin, John B. Weber, F. R. Green, C. B. Hill and W. P. Cooke.

PLAINDEALER, N. D.—The Allen-Tompkins Telephone Company, of Devil's Lake, has been granted the privilege to construct and maintain a local telephone system here.

MADISON, OHIO.—The Madison Telephone Company has commenced extensive improvements to its exchange at Geneva.

TOLEDO, OHIO.—Marshall & Fraser, of this city, have incorporated the Local Telephone Company at Norwalk, Ohio; capital, $250,000.

WARREN, OHIO.—The Warren & Niles Telephone Company is erecting a line to Champion from this city. Other extensions are also planned for this year.

BELLAIRE, OHIO.—The Enterprise Telephone Company, capital stock $25,000, has been incorporated by Robert McKelvey, Theo Neff, J. D. McKelvey, Frank Neff, Alex Neff, John W. Neff and W. T. Unterzuter.

TOLEDO, OHIO.—Sections of the switchboards of the Toledo Home Telephone Company's exchange have arrived and are being installed. Cables are being put up to afford long-distance service over the lines of the United States Telephone Company.

BATAVIA, OHIO.—The Bell Telephone Company is extending its lines throughout Clermont County and is establishing exchanges in Williamsburg, Bethel and Batavia. All the towns in the county are to be connected and free service is to be given throughout the county.

HAMILTON, OHIO.—The Hamilton Home Telephone Company has filed an answer to the injunction suit brought by the Bell Company. It denies that it intends to interfere with the operation of the Bell lines and claims that the Bell Company is stringing wires so as to interfere with the lines of the new company.

COOLVILLE, OHIO.—The Coolville Home Telephone Company has organized as follows: F. P. Ames, president; H. A. Cook and J. P. Parris, vice-presidents; Otto Barth, secretary; C. E. White, treasurer; W. E. Matlack, C. E. Burrows and James Drain, directors. The company is building lines in Belpre, Pomeroy and Olive townships. Connection will be made with West Virginia systems at Parkersburg.

CLEVELAND, OHIO.—Despite rumors to the contrary, the bankers' committee in charge of the affairs of the Everett-Moore Syndicate have not decided definitely to sell the assets of the Federal Telephone Company, nor is it believed that there is much likelihood of the assets being sold as an entirety. As the investigations into the affairs of this company become more thorough there is a growing desire that the property shall be maintained practically intact, since ɐɯdɯoɔ suoıʇɐɹnʇ ǝɥʇ fo ʍouıɥs sıuıod sıuɐdu ǝɥʇ sıǝɯ the investigations are improving almost daily and on the whole the property is much more valuable than was originally supposed. Negotiations have practically been completed for the sale of the majority stock interest in the Columbus People's Telephone Company and also the Federal interest in the unfinished plant at Dayton, Ohio. The parties who will obtain control of the properties are already heavily interested in the two companies, among them being H. A. Lanman, Frank Davis and Silas Huling, of Columbus, John T. Barlow and J. C. Rieber, of Dayton, and H. C. Critchfield, of Cleveland. The two exchanges will probably be consolidated and the company will include the small exchanges heretofore grouped as the Franklin County Telephone Company. The Federal holdings in the Columbus Company amount to $567,000, out of a total of $750,900. Negotiations are also in progress for the sale of the Detroit and Jackson, Mich., exchanges and it is expected that these will shortly be closed. On Jan. 1, 1902, the Federal Telephone Company owned 30,451 telephones, not including 2790 in the Akron exchange, in which the company has a minority holding; 4547 miles of pole line; 119,920 miles of wire; 178,920 poles. Of the lines, the United States long-distance lines measure 2680 miles.

STONY CREEK, ONT.—The business men of the town of Stony Creek purpose forming a company to establish a local telephone system.

OTTAWA, ONT.—The M. Welch Telephone Company is applying to the Legislature of New Brunswick for an act of incorporation to enable it to erect and operate telephone lines in the County of Carleton, N. B.

OTTAWA, ONT.—Toronto and Montreal capitalists are petitioning the Dominion Parliament for a bill of incorporation under the name of the Canadian Power Company to purchase or generate and transmit electrical or hydraulic power for lighting, heating or power purposes.

OTTAWA, ONT.—The visit of a large deputation, representing numerous Ontario municipalities to Ottawa, recently, resulted in a notable victory for the municipalities in regard to the proposed telephone legislation of the Dominion Government. The Minister of Justice withdrew the bills that were before the Canadian Parliament, and announced that another bill, in which the interests of municipalities as well as vested interests would be carefully guarded, will be introduced at the next session of Parliament. Beyond desiring to assume control of telegraph and telephone development, the Government is willing to let municipalities have a large say in the drafting of whatever legislation may come before Parliament on the subject.

OTTAWA, ONT.—An initial move has been made towards securing for the people of Ottawa relief from the present system of telephone monopoly, whereby the Bell Telephone Company is enabled to charge what are regarded as exorbitant figures for telephone service. Recently the company advanced its rates, and now the citizens are paying $45 for office and $30 for residence service. One year hence the agreement between the city and the company expires, and the corporation will then be at liberty either to establish a system of its own, or enter into a more advantageous agreement with some other concern. At the civic elections, last January, the ratepayers of Ottawa voted in an overwhelming majority in favor of municipal ownership and operation of the telephone system of the city. A resolution is now before the City Council for the purpose of inviting proposals from individuals or companies: First, for installing a telephone system equal at least to that of the Bell Telephone Company, ready for operation April, 1903, and capable of serving 4000 subscribers; the proposals to state whether the system will be overhead or underground wires; and, second, what amount of money an individual or company will pay the city of Ottawa annually for the privilege of operating a telephone system for a period of ten years, equal to the Bell Telephone Company, the rate to subscribers not to exceed $20 per annum.

OTTAWA, ONT.—Mr. Oscar W. Rogers, of New York, recently addressed the City Council of the city of Hamilton, Ont., and afforded such an insight into the prospects of telephone competition, that the Council, which was about to close a five-year contract granting the Bell Telephone Company an extension of its exclusive franchise, decided to postpone action. Mr. Rogers submitted a scheme for installing 3,000 telephones in Hamilton, the rates to be $15 for business and $10 for house telephones. The installation is to be on the automatic principle, and will involve working expenses to the amount of only $12,000 a year, and depreciation of plant, $8,400. He also stated that he was negotiating with the city of Toronto for the installation of a similar, but very much larger plant. In the itemized statement as to the cost of an automatic exchange for the leading cities of Canada, the capital of the Dominion is included, on the following scale: Population, 60,000; business telephones, 1500; residence telephones, 1500; business rates, $15; residence rates, $10; average length of lines, ¼ mile; percentage in conduits, 50; cost of central equipment, $15,000; subscribers' equipment, $30,000; lines in conduits, $90,000; lines on poles, $45,000; buildings, $5,000; total cost, $185,000. Depreciation—conduits, 3 per cent; others, 6 per cent; working expenses, $12,000. This would afford a revenue of $37,000 with working expenses of $12,000, leaving over $25,000 annually for depreciation, sinking fund on capital investment and profit.

PITTSBURG, PA.—About 500 linemen, employed by the local telephone and electric lighting companies, have gone on a strike for an advance in their wages. This was decided upon by a meeting of Local Union No. 14, of the International Brotherhood of Electrical Workers. The men are now getting $2.50 per day, but they want $3.00. All the companies to whom the scale has been presented have refused to accede to the new demands.

SHERBROOKE, QUE.—The shareholders of the People's Telephone Company, of Sherbrooke, have approved of an issue of $25,000 preference stock.

NASHVILLE, TENN.—The Tennessee Telephone & Telegraph Company and the Memphis Company have been seeking franchises in Nashville.

UVALDE, TEX.—This place is to have two new long-distance telephone lines, one of which will go to San Antonio and the other to Carrizo Springs and intermediate points.

COLUMBIA, VA.—The James River Valley & Fluvanna Telephone Company has recently declared a dividend of 6 per cent and has a good reserve fund. This company is in excellent condition and hopes soon to extend its line to Richmond.

SPOKANE, WASH.—Doerr, Mitchell & Company, of Spokane, have just closed a contract with the United States Selector Telephone Company for the sole agency of this company for Washington and Northern Idaho. Mr. Mitchell has secured a franchise, and will install a telephone system taking in the farming district around Spokane.

CLARKSBURG, W. VA.—The Sardis Telephone Company has been granted a franchise to install a system along the county roads.

MADISON, WIS.—The Farmers' Union Telephone Company, of Dane County, has increased its capital stock from $1,000 to $4,000.

DELAVAN, WIS.—The Badger State Telephone Company is planning to extend its line from Delavan to Racine by way of Rochester.

FOND DU LAC, WIS.—The Theresa Union Telephone Company has secured a franchise from the town of Fond du Lac to erect lines in town.

CHIPPEWA FALLS, WIS.—During the coming summer the Wisconsin Telephone Company will rebuild its exchange in this city at a cost of $20,000.

MADISON, WIS.—The Wind Lake Farmers' Telephone Company has been incorporated and will build a line from Watertown to Wind Lake and North Cape.

MARINETTE, WIS.—A new telephone line is to be built in Marinette county from this city to Crivitz and Wausaukee, 30 miles. It is designed to be a farmer telephone line. The estimated cost is $8,000.

BARABOO, WIS.—The Baraboo Telephone Company has made arrangements for the construction of a telephone line connecting Madison and La Crosse and all intermediate points, with headquarters at Baraboo.

MADISON, WIS.—The Althens Telephone Company, of Althens, has been incorporated with a capital stock of $750. The incorporators are J. Brann, G. A. Kreutzer, W. G. Cotanche, F. Reitbrock and W. C. Klamm.

KENOSHA, WIS.—The Kenosha County Farmers' Telephone Company, recently orgnized, is making another effort to get into the city. The Wisconsin Telephone Company is trying to arrange with the company to use its long distance lines.

MILWAUKEE, WIS.—The annual meeting of the Wisconsin Telephone Company just held resulted in the election of the following directors: F. G. Bigelow, Charles Ray, H. F. Whitcomb, Jesse Stone, F. P. Fish, Alonzo Burt, John Balch, Thomas Sherry, P. Dexter, W. S. Hutchinson and H. J. Pettingill. The engineering department is now engaged in making estimates on the cost of proposed improvements.

ELECTRIC LIGHT AND POWER.

EUFAULA, ALA.—At a special meeting of the City Council recently the matter of lighting the city, which has been quite a perplexing one, was definitely settled. A contract was made with the present electric company for a period of ten years. The conditions are that the company is to build a new and modern plant and also install an incandescent system.

SAN FRANCISCO, CALIF.—The Walker Electric Power & Irrigation Company has been incorporated in Los Angeles, Calif., by J. A. Walker, J. P. Reed, B. Darlington. The capital stock is $100,000.

SAN FRANCISCO, CALIF.—The Bay Counties Power Company recently consummated the purchase of a large additional supply of power water in Butte County, Calif. It will be possible to erect an electric power plant, on Butte Creek above the Butte Creek Power Company's dam, that will give a combined capacity of 20,000 hp. The water can be used twice, on account of the high head available. An additional pipe line and water wheel will be installed at the Centerville power station, whence current is now being transmitted to the main electric power lines of the Bay Counties system. A special high tension line will be constructed to connect with the gold dredging plants near Oroville.

COLORADO SPRINGS, COL.—The Guanajuato Power & Electric Company has been incorporated at Colorado Springs, with a capital of $3,000,000. Incorporators, L. E. Curtis, Henry Hine and I. W. Bondbright. The company will have headquarters at Colorado Springs, and will operate in the Republic of Mexico.

SALIDA, COL.—A franchise has been granted J. C. Vanriper and W. M. Mathews, of St. Louis, by the City Council of Salida, Colo., for the operation of a large electric power plant. Power and light will be furnished Salida, Monarch, Garfield, Turrett and Whitehorn districts. A car system will also be operated connecting Salida with Poncha Springs and the new smelters.

MOORE'S HILL, IND.—The Town Council has made provision for an electric light plant. A company will be organized at once and the plant installed this summer.

PETERSBURG, IND.—An electric light plant will probably be established in this town during the summer. Further particulars may be obtained by addressing Mr. Frank C. Thomas, the town clerk.

NEW CASTLE, IND.—The annual report of the local municipal electric light plant shows that each arc light cost $20.70. Other cities, the report says, are paying from $55 to $85. This city has also a natural gas plant and derives a good revenue from both the electric light and the gas plants.

LOUISVILLE, KY.—The Peerless Manufacturing Company has taken possession of its new plant, which is said to be the largest and best equipped in the country devoted exclusively to the manufacture of iron and brass fireplace goods. Electric power is used in this plant, each department being operated independently.

HILLSDALE, MICH.—At the next election the voters will decide on the proposition of enlarging the municipal lighting plant. The measure will probably pass.

ALBANY, N. Y.—The Addison Electric Light & Power Company, Addison, Steuben County, has been incorporated; capital, $40,000. Directors: F. H. Wheaton, Fannie A. Wheaton, Addison; G. M. Kellogg, Hornellsville.

WARREN, OHIO.—A special election will be held soon to decide on the proposition of a municipal lighting plant. The lighting service is now furnished by a New York corporation.

OTTAWA, ONT.—The Montreal Heat, Light & Power Company proposes to double the capacity of the Chambly power house by the addition of four more generators. The street lamps of Montreal will be changed over to the alternating current type. The company now has four power houses, three in the city operated by steam, and the Chambly plant run by water power, which when completed will alone give the company 20,000 horse-power. This will enable the company to dispense almost entirely with the steam power plants.

OTTAWA, ONT.—An agreement has been reached whereby leading capitalists of Toronto, who are connected with the street railway, the electric light and the General Electric companies, will build a pole line for the transmission of electric energy from Niagara Falls to Toronto, as soon as such energy is available. Mr. William Mackenzie, of the Toronto Eleectric Railway, and President Pellatt, of the General Electric Company, are the chief promoters. These companies consume over 12,000 horse-power daily. It is probable that the extension of the electric railway from Mimico along the lake shore will be the first result of the new agreement.

ATHENA, ORE.—A. M. Gillis, of this place, has obtained an electric light franchise.

PHILADELPHIA, PA.—Plans for a new power house in this city, to cost $300,000, have been filed by the Southern Electric Light & Power Company. The building, which will be erected at Twenty-sixth and Christian streets, will be five stories high and 163 by 166 feet in area.

SALT LAKE CITY, UTAH.—The Seaton Electric Company has completed the installation of its auxiliary plant, two miles below Idaho Springs, Colo., and started the plant. It will be used for supplying the mines and mills that are now taking power from the main plant.

THE ELECTRIC RAILWAY.

TAMPA, FLA.—Application has been made for a charter for the Tampa Municipal West Coast Development Company, with a capital of $1,000,000. The company will build a street and electric light plant in Tampa and construct 200 miles of trolley lines over South Florida with Tampa as the center.

MACKAY, IDAHO.—The owners of the electric railway which is building from Mackay to the mines in Thunder Mountain, a distance of 10 miles, have decided to enlarge the power plant from the first plans and will light their smelter and mines, as well as others in the district, using about 2000 lights in all.

GALESBURG, ILL.—The People's Traction Company is building a power plant and constructing 12 miles of road. The electrical equipment is being supplied by the General Electric Company.

DES MOINES, IA.—The Iowa Construction Company, of Creston, has been incorporated with $10,000 capital, with Lyman Waterman, of Omaha, at the head, to build the proposed electric line from Creston to Winterset, and probably on to Des Moines.

OSKALOOSA, IA.—By an overwhelming majority the voters of this city decided to give the Interurban Construction Company a franchise for twenty-five years to construct and operate a street railway system in this city and to light the city streets for the same period.

FT. WAYNE, IND.—The contract for constructing an electric road between Angola and Goshen has been let to Flint, Jones & Co., of New York City, and the firm is advertising for a large force of men. The townships have voted $80,000 in subsidies for this road.

MUNCIE, IND.—C. L. Briggs, of Cleveland, O., has been awarded the contract to construct the power house at Eaton, and sub-stations in Muncie, Hartford City, Bluffton and Ft. Wayne, for the Muncie-Hartford City Electric Railway. Work is to begin at once. The estimated cost of the road is $1,000,000.

NOBLESVILLE, IND.—The Central Traction Company of Indiana has sold out to the Union Traction Company, and its franchises in this and other towns have been surrendered and similar grants given to the Union Traction Company. This sale ends the long fight between these two companies and settles the fact that there will be but one line between Kokomo and Indianapolis.

MINNEAPOLIS, MINN.—The new storage battery plant of the Twin City Rapid Transit Company is now in service. It is utilized during the rush hours from 6 to 8 p. m., and will be drawn on in case of emergencies. It is charged from the water power plant, utilizing the water which has hitherto run to waste during the night. The plant has storage capacity sufficient to operate the St. Paul and Minneapolis systems for one hour. There is a similar battery plant at St. Paul. The Minneapolis plant consists of 315 cells of battery, each cell containing 43 plates.

MANKATO, MINN.—The Mankato & St. Peter Railway & Lighting Company has been organized to build an electric street railway in this city, with a suburban line to St. Peter by the way of Kasota, and also to construct an electric lighting and gas plant. The capital stock was placed at $300,000. The incorporators are: Mayor Nic Peterson, W. D. Willard, George M. Palmer, Col. Gus Widell, W. L. Nixon, A. E. Clark, A. G. Meyer, Leo S. Lamm, S. Willharts and W. G. Moerr, of Mankato; Mayor W. H. Mueller and C. D. Davis, of St. Peter, and C. W. Babcock, of Kasota. The directors elected W. L. Nixon, president; W. D. Willard, vice-president; A. E. Clark, secretary, and W. G. Moerr, treasurer.

BUFFALO, N. Y.—The Buffalo, Springfield & Cattaraugus Railway Company will build a power house of 2000-hp capacity for the operation of its road, which is now being constructed.

NEW YORK, N. Y.—The Health Board has ordered the Metropolitan Street Railway Company to remove "flat" wheels from its cars or take the cars off the streets. It is claimed that the noise of the "flat" wheels on the West Thirty-fourth street line keeps the residents along that thoroughfare awake at night, hence the complaint to the Board of Health.

CLEVELAND, OHIO.—The Eastern Ohio Traction Company has increased its capital stock from $1,000 to $2,500,000.

ALLIANCE, OHIO.—The Stark Electric Railway Company has been granted a franchise for its line through Alliance; also a franchise for a lighting and power system. The latter may be revoked if the city decides to build its own lighting plant.

CLEVELAND, OHIO.—Stockholders of the Cleveland, Painesville & Eastern Railway will meet April 10 to pass on a proposition of increasing the capital stock from $1,500,000 to $2,000,000. The object is to provide funds for the Ashtabula extension and to liquidate unfunded and floating debt and other liabilities.

ELYRIA, OHIO.—The Cleveland, Elyria & Western Railway Company is preparing to increase the capacity of its Elyria power house and has given a contract to the Westinghouse Machine Company for two Parsons turbines to be direct-connected to generators. The contract will soon be awarded for the boilers, mechanical stokers, economizers, etc. This, it is said, will be the first electric railway plant in the country to use steam turbines.

PROVIDENCE, R. I.—The Senate has passed the so-called Merger Act, which incorporates under the title of the Rhode Island Company, the United Traction, the Narragansett Electric Lighting and the Providence Gas companies, with a combined capital of $16,000,000. The amount of capital stock mentioned in the act is $2,000,000, and power is given to increase this at any time it becomes desirable.

NEW INDUSTRIAL COMPANIES.

THE UNION RAILWAY POWER & ELECTRICAL COMPANY has been incorporated at Jersey City, with a capital of $100,000. Incorporators, N. R. Vanderhoof, W. Monds Greene and Edward Cuddy.

THE HERZOG SYSTEMS COMPANY has been incorporated at Trenton, N. J., to manufacture and deal in telephones, etc.; capital, $1,500,000. Incorporators, Theodore F. Hicks and Norton F. Paton, of Jersey City.

THE McKIBBEN GAS ENGINE & ELECTRIC MANUFACTURING COMPANY, of Lima, Ohio, has been incorporated, with $10,000 capital, by C. W. McKibben, L. L. Thomas, John Carnes, Irvin Munch and W. S. Walter.

THE NATIONAL TELEGRAPHONE COMPANY, capital, $2,000,000, has been incorporated in New York to manufacture telegraph and telephone instruments. Incorporators, Edmund L. Grannel, George E. Milligan and Allen E. Kirby.

THE NORTHERN ELECTRICAL CONSTRUCTION COMPANY, capital, $100,000, was organized at La Crosse, Wis., to build telephone and light plants and city and interurban electric lines in Wisconsin, Minnesota, Iowa and the Dakotas. Several large contracts have already been secured in the northern part of Wisconsin.

THE BUFFALO AUTOMOBILE STATION COMPANY has been organized at Buffalo, N. Y., with a capital of $10,000. The directors are Wm. Hamlin, Frank A. Babcock, Charles Wesley, Jacob Amos and F. A. Baldwin, jr. The company will build automobiles and automobile parts and operate charging stations for electric automobiles.

LEGAL.

METROPOLITAN LEASE VALID.—Justice Gildersleeve, in the New York Supreme Court, Special Term, has denied the application of Messrs. Content and Wormser to continue the temporary injunction restraining the Metropolitan Street Railway from leasing its properties to the Interurban Company. This is a great victory for Metropolitan. The suit, however, still remains on the calendar awaiting trial on the original complaint. In his decision Justice Gildersleeve said there was not the slightest indication of fraud or anything improper. The lease was a fair one and well within the power of the Metropolitan Company to make. He said that it had been ratified by its stockholders and board of directors and that the charges made by the plaintiffs had not been established.

OBITUARY.

MR. J. LAMBERT.—Many of our readers will regret to learn of the death of Joshua Lambert, vice-president of the Clayton & Lambert Manufacturing Company, Detroit, Mich., which occurred March 1, 1902. He had been ill for over a year, steadily failing, still his interest in the company's business, which he had helped to build up from a small beginning to the largest in its line in the world, daily brought him to the factory, and, though unable to perform his customary duties, up to the last day of his life he gave the company the benefit of his counsel and was deeply interested in all that would advance its interests. "Uncle Jay," as he was familiarly called by his many friends and the company's employes, was born in Livonia, Mich., Feb. 14, 1834. He was a kind and loving father and a sympathetic friend whose heart was large enough for all his wide circle of friends, all of whom will mourn his loss. His sunshiny disposition and his anxiety to make life pleasant for others made friends and confidants of all who knew him, particularly the employes of the Clayton & Lambert Manufacturing Company, and it was touching to see the sympathetic glances which followed him during the last year as, according to his usual custom, he visited the various departments. It will therefore be readily understood that his sudden death was a sad blow to his family and to his many friends. He leaves a widow and four children, three sons and one daughter, all of whom reside in Detroit. The three sons are part owners of the company, which was organized in 1889 with the following officers: Nelson J. Clayton, president; Joshua Lambert, vice-president; J. E. Lambert, secretary and treasurer, who together with Charles R. Lambert and Bert Lambert were directors, all having served the company continuously since it was organized.

PERSONAL.

J. C. BARCLAY.

MR. JOHN C. BARCLAY, who has just been appointed to the position of electrical engineer of the Western Union Telegraph Company, was born in Greensburg, Pa., April 17, 1856, and, like many others who have attained prominence in the electrical profession, began his career as a telegraph messenger. As a carrier of despatches he was in the employ of the Pennsylvania Railroad, and in 1870 he obtained his first position as an operator—at Connellsville, Pa. He afterwards held positions in various other places, and was at one time an inspector for the Automatic Fire Alarm System in New York. Since 1882 he has been connected with the Western Union Telegraph Company, first in Chicago, rising from the rank of operator to that of division electrician, which latter position he held at the time he received the appointment as electrical engineer, with headquarters in New York. Personally, Mr. Barclay is highly esteemed by all who know him, and professionally he is, by long experience, eminently qualified to fill the important position to which he has been called. He is progressive and energetic,

and no doubt, under his management, the electrical interests of the great corporation he represents will be lifted to the highest plane attainable. Mr. Barclay assumed his new duties on April 1.

MR. LUTHER STIERINGER has returned to New York City from a long vacation down South.

MR. THOS. A. EDISON came home last week from his plantation in Florida, much the better for the change.

MR. WILLIAM BOEHM, chemist, of Berlin, Germany, is now visiting this country and inspecting electrical installations, etc.

MR. A. S. BROWN, for many years electrical engineer of the Western Union Telegraph Company at New York, has resigned owing to ill-health.

MR. JOHN A. MATHEWS will read a paper on April 11 before the American Chemical Society on the electrical conductivity of alloys. He is the secretary of the society.

MR. CHARLES S. COLTON, assistant manager of the Westinghouse Electric & Manufacturing Company's plant at Cleveland, has resigned to become works-director of the Ludwig-Loewe Company, Berlin, Germany.

MR. WM. MARCONI was a guest at the "Irish dinner," given last Saturday night by the members of the British Schools and Universities Club, at the New York Athletic Club. He spoke on the topic, "The Irish and Electricity." The dinner was private. He sailed on Wednesday for England.

MR. ARTHUR J. WOOD, who has been engaged for some time past in technical journalism and was associated with the *Railroad Gazette*, has been appointed professor of mechanical and electrical engineering at Delaware College, Newark, Del., and has taken up his duties there.

SWAN-CLARK.—Mr. J. J. Swan, at one time on the editorial staff of *Engineering News* and now with the engineering department of the Ingersoll-Sergeant Drill Company, was married on April 2 at Plainfield, N. J., to Miss Helen R. Clark, daughter of Mr. and Mrs. Edward B. Clark, of that place.

MR. ARTHUR BERGTHEIL, of the British electrical engineering and contracting firm of Bergtheil & Young, Camomile Street, London, E. C., England, which concern represents the interests of the Bullock Electric Manufacturing Company, of Cincinnati, in the United Kingdom, is now on a visit to America. He is at present at the Waldorf-Astoria.

MR. R. FRANK HARTFORD, consulting engineer, has moved his office from Atlanta, Ga., to Memphis, Tenn., in the Randolph Building. He has recently designed and installed several isolated lighting and power plants in Arkansas and Louisiana, and is now at work on a long-distance power transmission project in Northern Alabama.

MR. O. A. STRANNAHAN, formerly of the Chicago office of Westinghouse, Church, Kerr & Company, now head of one of the departments at the new Trafford Park, Manchester, works of the British Westinghouse Electric & Manufacturing Company, Limited, has arrived from Europe on a three weeks' visit. He is at present in Pittsburg.

PROF. LOUIS A. HERDT, who is associated with Prof. R. B. Owens in the electrical engineering department of McGill University, has been taking a vacation in the United States for some weeks, seeking restoration from ill-health. He was in New York this week, greatly improved by the change, and has returned to McGill to resume his work.

MR. F. A. PICKERNELL, in charge of the engineering department of the long-distance branch in New York City of the American Telephone & Telegraph Company, has been transferred to Boston, owing to the consolidation of the company's engineering work there. Mr. Pickernell is greatly missed in many circles in New York and his early return is hoped for.

MR. T. S. McLOUGHLIN, well known throughout the South in the electric construction business, with an office at 824 Union Street, New Orleans, is now also vice-president and general manager of the Hartwell Electric Company, Perdido and Carondelet Streets, New Orleans, in which capacity his experience will undoubtedly prove invaluable to the new concern.

MR CHAS. F. SCOTT, president of the Engineers' Society of Western Pennsylvania, delivered a very interesting address at the annual banquet last February, and this has now been issued in pamphlet form. Mr. Scott notes incidentally in his speech that within five years the Society has elected two secretaries and two presidents from electrical engineering ranks.

COL. JOHN T. DICKINSON, who has heretofore represented the Consolidated Railway Electric Lighting & Equipment Company in Chicago, has been transferred to New York as general agent, with headquarters at the general offices of the company, 100 Broadway; and Mr. Geo. W. Carhart has succeeded Col. Dickinson as general agent of the company in Chicago and the West.

MR. OSCAR T. CROSBY, the well known electrical engineer and manager of traction and power properties at Washington, D. C., writes for the *Century*, for April, a very interesting article embodying his reminiscences of King Menelik, of Abyssinia. Mr. Crosby went through the country in 1900 and explored the Blue Nile regions that had not been previously visited, but since investigated also by Mr. Hugue Le Roux.

MR. HENRY A. REED, the veteran manager of the Bishop Gutta Percha Company, in the course of an interview in the *New York Times*, on an alleged increase in the supply of gutta percha, expressed the hope that it might be true, and said as to its present uses: "Gutta percha furnishes material for vessels, bottles, pitchers, and panels for acids and alkalies. Also for machinery belting in places where there are acid or chemical fumes. Again in electrotyping to get impressions from steel plates for duplicating, and by the United States Government for gun impressions in gun testing. And just now it is in great demand for golf balls. We are not yet making ping-pong balls of it."

NEW YORK ELECTRICAL SOCIETY.—At the last meeting of the society the following members were electeed: C. J. Sweek, 507 East Fifty-fifth Street, New York; Albert Granish, 54 East Seventh Street, New York; F. B. Sage, 123 Liberty Street, New York; Edward Cromwell Cockey, Room 141, 195 Broadway, New York; Walter D. Francis, 253 Broadway, New York; Frederick Pearce, 18 and 20 Rose Street, New York; C. August Harsch, 916 Forest Avenue, New York; W. H. McCormick, 575 East 153d Street, New York; Byron W. Smith, care of Western Electric Company, 57 Bethune Street, New York; Alfonse Kaufman, 256 West 129th Street, New York; W. D. Sargent, 81 Willoughby Street, Brooklyn, N. Y.; Frank C. Mason, 16 Smith Street, Brooklyn, N. Y.; Walter E. Brown, 763 Nostrand Avenue, Brooklyn, N. Y.; Edwin W. Babcock, Edison Building, Brooklyn, N. Y.; Richard E. R. Lubben, 77 Murray Street, Elizabeth, N. J.; Chas. S. Dunn, 315 Market Street, Newark, N. J.; Edward Kassel, 142 Smith Street, Evergreen, L. I.; Fred W. Lawson Fullerton, 46 North Twenty-second Street, East Orange, N. J.; Geo. W. Williams, 56 Montgomery Street, Jersey City, N. J.; S. Marshall Williams, 56 Montgomery Street, Jersey City, N. J.; Wm. G. Chamberlain, 215 North Avenue, Cranford, N. J.

Trade Notes.

MESSRS. BLOOD & HALE, Boston, Mass., have removed their offices from the Equitable Building to the Delta Building, 10 Postoffice Square.

TO MANUFACTURE ELECTRICAL NOVELTIES.—Mr. W. P. Freeman will open a factory in Cridersville, Ohio, for the manufacture of electrical novelties.

SOCKETS AND RECEPTACLES.—Pass & Seymour, Inc., Solvay, N. Y., have issued a neat little pamphlet giving illustrations of their weatherproof sockets and receptacles.

THE MASURITE EXPLOSIVE COMPANY announces that on April 10 it will succeed to the business of the Safety Explosive Company, of New York. Its office is at 43 West Eighty-seventh Street, New York. Mr. Fred. L. M. Masury is president.

EYANSON & ARMPRIESTER.—Notice appears under date of April 4 that the partnership existing under the firm name of Eyanson & Armpriester has been dissolved by mutual consent and that the business will be continued by George T. Eyanson at the same address, Seventh and Commerce streets, Philadelphia. Mr. Eyanson assumes all liabilities and collects all accounts.

THE STANDARD POLE & TIE COMPANY, of 44 Broad Street, New York, has been awarded the contract for the poles to be used on the line of the Columbus, Delaware & Marion Electric Railway, running from Columbus to Marion, Ohio. The pole which it will supply is the Southern white cedar or Juniper, which has of late become so popular for interurban lines owing to its symmetry and freedom from sap and butt rot.

LIGHTNING ARRESTERS.—Catalogue No. 35, dated March 15, 1902, issued by Garton-Daniels Company, Keokuk, Iowa, describes the latest models of its well known lightning arresters. It contains also a practical statement of the methods in use to-day for the protection from lightning, of electric railway, light and power circuits. It is the most complete publication of this character that has been issued in the history of the electrical business, and should be in the hands of every one interested in the subject. It will be mailed without charge on request to the Garton-Daniels Company, Keokuk, Ia.

S. K. C. BULLETINS.—Circulars No. 125 and 126 of the Stanley Electric Manufacturing Company are devoted to the subjects of condensers, and to a voltmeter compensator and voltaphone, respectively. The condenser circular describes and illustrates the S. K. C. condenser, and contains a diagram showing its method of connection to two-phase motors. The voltmeter compensator is designed for use in connection with a station voltmeter so that the latter will indicate the voltage at the center of distribution, instead of the voltage at the station, and is set to operate correctly at a given power factor. The voltaphone accomplishes practically the same result as the voltmeter compensator, but its function is to inform the power house through the medium of a telephone the exact voltage at the center of distribution or at any point on the line. An electrical impulse from the station releases a detent, and a spring sets the voltaphone mechanism in operation. There is a finger in contact with the pointer of a voltmeter and the arrangement is such that dot and dash signals are conveyed over the telephone line. By reference to a code the signal will indicate if the voltage is correct, or from 1, 2, 3 or 4 per cent above or below normal.

"THE LIGHT THAT NEVER FAILS."—There are a great many methods of lighting a church or other large auditorium now in vogue, some of them very good attempts at successful lighting, but the system that never seems to fail, and has scored over 20,000 successful installations in churches alone in all parts of the world, is that of the famous Frink reflector, familiarly known to thousands as "The Great Church Light," a title gained by nearly half a century of work in this line. Among more recent installations made by I. P. Frink might be mentioned Grace Evangelical Church, Scranton, Pa.; Zion Ev. Luth. and English Luth., Loudonville, Ohio; St. Luke's Luth., York, Pa.; Baptist, Picture Rocks, Pa.; Belmont Avenue Baptist, Springfield, Mass.; Bruns Avenue M. E., Detroit, Mich.; First Christian and German Presby., Shelbyville, Ind.; Dayspring Presby., Yonkers, N. Y.; Plymouth Congl., Des Moines, Ia.; Grove Avenue M. E., Johnstown, Pa. The lighting of a church auditorium successfully is not as simple a problem as it appears on the face of it, and mistakes occur where least expected. A consultation with this firm beforehand insures a successfully lighted church at a minimum expense, and it will be glad to forward literature, catalogues and all necessary information on receipt of required data as to size, etc.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED APRIL 1, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

695,913. INSTRUMENT FOR INDICATING THE PHASE AND FREQUENCY RELATIONS OF ALTERNATING CURRENTS; F. Conrad, Wilkinsburg, Pa. App. filed July 12, 1901. (See Current News and Notes.)

696,398. ARAMATURE COIL; A. F. Bachelder, Schenectady, N. Y. App. filed Nov. 3, 1900. In order to wind fine wires into rectangular coils and prevent them from slipping out of place, each turn is composed of a number of wires bound together side by side.

696,427. ELECTRIC INDICATING INSTRUMENT; R. Fleming, Lynn, Mass. App. filed Nov. 21, 1901. (See Current News and Notes.)

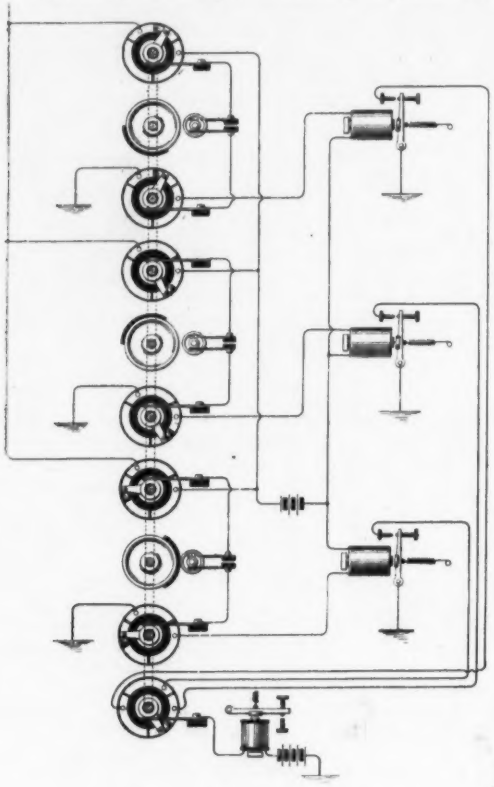
696,429. SOLDERING IRON; H. Geisenhoner and T. Van Aller, Schenectady, N. Y. App. filed Nov. 21, 1900. The resistance coil is wound on the shank of the iron and its layers are separated by a cord of heat-resisting insulating material.

696,447. ELECTRICAL SWITCH; E. G. Kastenhuber, Bloomfield, N. J. App. filed June 6, 1901. Details of a push-button switch.

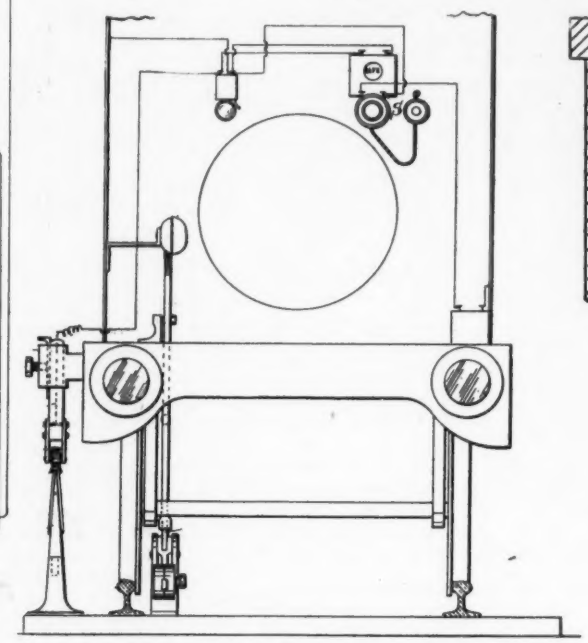
696,459. MEANS FOR PREVENTING CREEPING OF METERS; A. D. Lunt, Schenectady, N. Y. App. filed Oct. 23, 1901. (See Current News and Notes.)

696,473. ARMATURE REGULATOR FOR ELECTRIC CIRCUITS; F. C. Newell, Wilkinsburg, Pa. App. filed April 28, 1900. The invention consists in a shunt-circuit with its ends connected to opposite sides of the field of the generator and a solenoid in the generator-circuit adapted to open or close the shunt-circuit, according to the strength of the current in the generator-circuit.

696,488. COMMUTATOR; E. D. Priest and G. L. Schermerhorn, Schenectady, N. Y. App. filed Nov. 30, 1900. A commutator for dynamo-electric machines, consisting of conducting segments separated by soft insulating material which will wear or crumble away at least as fast as the segments.



696,715.—Wireless Telegraphy.



696,737.—Conduit for Underground Conductors.

696,489. SEPARATOR FOR BATTERY PLATES; James K. Pumpelly, Chicago, Ill. App. filed April 8, 1901. A fibrous glass is applied to the active surface of the positive pole electrode and retained in place by sheets of insulating material, each sheet having a series of parallel slots, the slots in adjoining sheets being placed at right angles with reference to each other.

696,496. ACCUMULATOR; Georges de Roussy de Sales and Francois Gueugnon, Lyons, France. App. filed March 13, 1901. The cathode consists of a supporting frame of aluminum enveloped with a very thin sheet of lead, which forms both a covering for the frame and a plate surrounding the frame. The sheet is perforated and provided on its external faces with projecting wires. After coating the sheet with oxide of lead, the cathode is rolled, which bends over the free ends of the wires, thereby holding the layer of oxide to the plate. The anode is composed of an aluminum tank having a flange for its suspension in a battery receptacle. The tank is divided into compartments by means of partitions of the same metal, and the interior coated with a layer of porous or other lead in such manner that each trough or compartment forms an anode. The tanks are perforated and are separated from each other by an absorbent material.

696,497. FUSE BOX; H. R. Sargent, Schenectady, N. Y. App. filed Aug. 29, 1900. The fuse passes through a hole in a partition, its terminals being on each side of the partition for the purpose of preventing an arc after the destruction of the fuse.

696,529. ELECTRICAL HOSE SIGNALING APPARATUS; G. G. Weitz, Medford, Mass. App. filed Dec. 5, 1900. A wire running the length of the hose is so connected with the coupling as not to be strained when the coupling is rotated to disconnect the hose.

696,597. COMBINED SWITCH AND PLUG RECEPTACLE BOX; F. J. Russel, New York, N. Y. App. filed May 1, 1901. Details.

696,599. ELECTRIC WATER HEATER; M. H. Shoenberg and H. Levt, San Francisco, Calif. App. filed April 10, 1901. A U-shaped pipe through which the water circulates and around one leg of which an electrical resistance is wound.

696,619. WATCHMAN'S TIME RECORDER AND SIGNAL; J. B. Yeakle, Baltimore, Md. App. filed Dec. 10, 1900. Unknown to the watchman switches can be arranged at a central office to record at the office the fact that the watchman has or has not visited a certain station.

696,647. DEVICE FOR PURIFYING WATER; J. M. A. Lacomme, Brooklyn, N. Y. App. filed Oct. 24, 1901. A pair of electrodes are adjustably located in a pipe through which water flows. The passage of sparks between the electrodes is said to purify the water. The invention resides more particularly in the means for adjusting the electrodes.

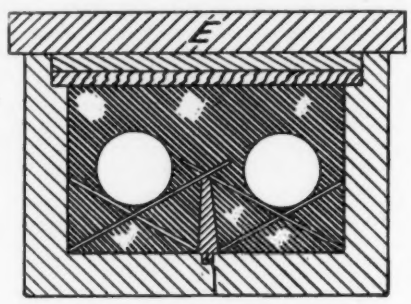
696,662. SYSTEM OF ELECTRIC LIGHTING AND APPARATUS THEREFOR; P. Lapertot, G. Villard and L. Pignaud, Lyons, France. App. filed Oct. 6, 1900. Means for supplying a current to several series of lamps successively during the half-period of the current and means for adding to the current thus supplied the self-inducted currents of the coils of the generator; whereby a momentary increase in the potential of the currents reaching the series of lamps in succession will be produced.

696,665. WIRE INSULATOR; W. C. Benbow, Columbus, Ohio. App. filed Jan. 4, 1901. Details.

696,702. ELECTRIC HOSE COUPLING; G. G. Weitz, Medford, Mass. App. filed Jan. 24, 1902. Details.

696,710. INTERIOR CONDUIT OUTLET BOX; W. F. Bossert, Utica, N. Y. App. filed Sept. 16, 1901. A sheet metal box whose bottom, sides and cover are formed with interlocking parts, the construction intended to cheapen the cost of manufacture.

696,715. WIRELESS TELEGRAPHY; J. Burry, Fort Lee, N. J. App. filed Dec. 6, 1899. In order that the receiver shall record dots and dashes distinctly, a number of coherers are employed. Means are provided for throwing each coherer first into a collector circuit; second, into the local circuit containing a battery and a relay, and third wholly out of circuit, and for repeating this cycle of operation indefinitely.



696,811.—Railway Signaling and Communicating Apparatus.

696,737. CONDUIT FOR UNDERGROUND CONDUCTORS; F. Jones, Liverpool, England. App. filed Sept. 4, 1901. Bare conductors are temporarily held in the conduit by non-conducting supports and plastic insulating material is then filled into the spaces around the conductor.

696,752. MEANS FOR AUTOMATICALLY CONTROLLING CAR MOTORS AND BRAKES; J. H. Robertson, New York, N. Y. App. filed July 25, 1899. The motorman stands upon an auxiliary platform and when he leaves it, the current is automatically shut off and the brakes applied.

696,757. SHUNT FOR ELECTRICAL INSTRUMENTS; M. C. Rypinski, Schenectady, N. Y. App. filed Sept. 5, 1901. A shunt for an electrical measuring instrument containing a plurality of transverse corrugations to serve as retainers for a more readily fusible metal, such as solder.

696,775. ELECTRIC LIGHT SIGN; H. Tripp and G. E. Stephenson, Chicago, Ill. App. filed Dec. 17, 1901. Fastening clips are attached to the back of each letter and are adapted to be secured to two rods in the sign which carry the current as well as support the letters.

696,781. TROLLEY CATCHER AND RETRIEVER; C. F. Wilson, Brooklyn, N. Y. App. filed Aug. 12, 1901. Details.

696,807. ELECTRIC ARC LAMP; R. Froment, Paris. App. filed Sept. 7, 1901. Details.

696,811. RAILWAY SIGNALING AND COMMUNICATING APPARATUS; H. Gulliver, South Yarra, Victoria, Australia. App. filed July 9, 1901. A telephone and signal bell are arranged in the cab of the locomotive and in circuit with a contact brush and rail whereby a signal operator in a tower can, when necessary, communicate with the engineer.

696,880. TRACTION SYSTEM; F. J. Sprague, New York, N. Y. App. filed Dec. 16, 1898. (See Current News and Notes.)